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# EVALUATION OF COLLOCATED INTERMEDIATE AND WHOLESALE INVENTORY LEVELS

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## OPERATIONS ANALYSIS DEPARTMENT

NAVY FLEET MATERIAL SUPPORT OFFICE

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EVALUATION OF COLLOCATED  
INTERMEDIATE AND WHOLESALE  
INVENTORY LEVELS

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## ABSTRACT

This study quantifies the extent of improved customer support provided by intermediate levels of inventory collocated with wholesale levels of inventory. An October 1986 General Accounting Office (GAO) audit (Report NSIAD-87-19) recommended that Naval Supply Systems Command (NAVSUP) eliminate intermediate inventories which are collocated with wholesale inventories. Although the Navy initially concurred with this recommendation, subsequent analyses show that it is cost-beneficial to retain both inventories.

This report addresses four major areas: (1) the extent of collocation of intermediate/wholesale inventories, (2) the impact on intermediate inventory levels resulting from the removal of the collocated intermediate levels, (3) the degradation in Average Customer Wait Time (ACWT) resulting from eliminating collocated inventories, and (4) the cost to maintain the current ACWT given the removal of collocated intermediate levels.

Our analysis reveals that the removal of collocated intermediate levels produces a one-time inventory reduction of \$5.6M for 1H Cog and \$5.8M for 1R Cog, but inflates ACWT by at least 20% (72 hours) for 1H Cog and 5% (14 hours) for 1R Cog. To maintain current ACWT while eliminating the collocated intermediate level, we estimate the wholesale levels would require a substantial increase in investment (\$43.8M for 1H Cog, \$87.1M for 1R Cog) of at least eight times the decrease realized by the elimination of intermediate levels. In addition to the one-time costs, annual costs to hold and maintain these additional wholesale inventories will exceed the annual savings in intermediate inventories by this same factor of at least eight to one. Therefore, the elimination of intermediate levels for collocated wholesale material is not considered cost-beneficial.

## TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	i
I. INTRODUCTION	1
II. ANALYSIS	2
A. DATA	2
B. DEFINITIONS	3
C. EXTENT OF COLLOCATION	7
D. IMPACT ON INTERMEDIATE INVENTORY LEVELS	12
E. DEGRADATION IN ACWT	23
F. COST TO MAINTAIN CURRENT ACWT	36
G. COST-BENEFIT COMPARISON	41
III. SUMMARY AND CONCLUSIONS	45
IV. RECOMMENDATIONS	47
APPENDIX A: REFERENCES	A-1
APPENDIX B: EXTENT OF COLLOCATION	B-1
APPENDIX C: IMPACT ON INTERMEDIATE INVENTORY	C-1
APPENDIX D: IMPACT ON ACWT	D-1

## EXECUTIVE SUMMARY

1. Background. A General Accounting Office (GAO) Audit Report NSIAD-87-19 recommends that Navy eliminate those intermediate level assets which are collocated with wholesale assets for the same item. GAO argues that the levels are duplicate because the same demand was counted twice: once to build the wholesale level and again to build the intermediate level. In addition, the audit claims that there is no advantage in response time since wholesale and intermediate assets reside in the same bin. In response to the GAO audit, the Navy agreed to eliminate those collocated intermediate levels which do not provide better response time to the user than could be provided with wholesale level stocks alone.

2. Objective. To quantify the customer support provided by intermediate levels collocated with a wholesale level using a cost/benefit approach.

3. Approach. We address four major areas: (1) the extent of collocation, (2) the impact on intermediate inventory levels from removing collocated intermediate levels, (3) the degradation in Average Customer Wait Time (ACWT) from removing collocated intermediate levels, and (4) the cost to maintain the current ACWT given the removal of collocated intermediate levels. First, we measured the extent of collocation for each of six Naval Supply Centers (NSCs) from 1 January 1985 to 1 January 1989. Secondly, we used current stock point data to measure the impact on the intermediate inventory levels, if either the collocated retail items or all retail items were removed from the stock point. (Even though GAO only recommended the removal of collocated intermediate levels, we also considered the costs and benefits of removing all intermediate stock point levels due to difficulties of identifying and segregating collocated retail material from other retail material.) We computed the Average

Funded Investment Level (AFIL) for all retail items and for collocated retail items in order to evaluate the potential savings of GAO's recommendation.

Third, we computed the impact on ACWT of eliminating collocation in terms of additional hours delay in delivering material to the customers. Fourth, we examined the necessary improvement in wholesale effectiveness and added wholesale investment required to offset the degradation in ACWT if GAO's recommendation were implemented.

4. Findings. For 1H Cog retail items, 95% of the total assets are for demand-based items, but only 8% of the total assets are for intermediate retail level requirements. Eliminating the collocated retail levels would result in a one-time net reduction to retail levels of \$5.6M. However, this reduction would increase ACWT by 72 hours or 20%. (This increase is to ACWTs which are already two to three times the OPNAV goal of 125 hours.) To maintain today's ACWT while removing the collocated intermediate stock point levels requires an additional one-time wholesale inventory expenditure of \$43.8M or \$8 for every \$1 saved in retail levels. (Note that this expenditure merely maintains today's ACWT; it does not do anything in terms of improving the ACWT to reach its goal.) Eliminating all intermediate stock point levels would yield a one-time reduction in retail levels of \$25.1M. But this reduction would increase ACWT by 100 hours or 28%. To maintain today's ACWT while removing all retail levels requires an additional one-time wholesale inventory expenditure of \$106.1M or \$4 for every \$1 saved in retail levels. In addition to the one-time savings/costs explained above, the annual costs to hold and maintain these retail/wholesale inventories will accrue in the same proportion as the one-time savings/costs.

For 1R Cog retail items, 99% of the total assets are for demand-based items, but only 10% of the total assets are for intermediate retail level requirements. Eliminating the collocated retail levels would result in a net one-time reduction to retail levels of \$5.8M. However, this reduction would increase ACWT by 14 hours or 5%. To maintain today's ACWT while removing the collocated retail levels requires an additional one-time wholesale inventory cost of \$87.1M or \$15 for every \$1 saved in retail levels. Eliminating all intermediate stock point levels would yield a one-time reduction in retail levels of \$55.5M. But this reduction would increase ACWT by 24 hours or 8%. To maintain today's ACWT while removing all retail levels requires an additional one-time wholesale inventory expenditure of \$258.1M or \$5 for every \$1 saved in retail levels. In either scenario, annual costs would accrue in the same proportion as the one-time savings/costs.

5. Conclusions/Recommendations. Our analysis shows that the elimination of either collocated retail or all retail levels would impact negatively on ACWT. The expected costs of boosting wholesale levels to compensate for this reduction in ACWT would result in an additional expenditure of at least \$4 for every \$1 saved in intermediate levels. In summary, the collocation of wholesale and retail levels, which resulted from the Retail Inventory Management and Stockage Policy (RIMSTOP) initiative, has paid for itself in terms of customer support. Therefore, we recommend that existing intermediate levels which are collocated with wholesale levels be maintained for both 1H and 1R Cog material.

## I. INTRODUCTION

An October 1986 General Accounting Office (GAO) audit recommended that Naval Supply Systems Command (NAVSUP) eliminate intermediate (retail) inventories which are collocated with wholesale inventories (documented in GAO Audit Report NSIAD-87-19, reference (1) of APPENDIX A). The GAO audit claimed that there is no advantage in response time since, for items with collocated levels, both wholesale and retail assets reside in the same storage bin. The Navy's response to the GAO audit stated, "The Navy will eliminate those intermediate inventories that are located at the same stock points as wholesale inventories and do not provide better response time to the user." Since identification of wholesale and retail material is currently impossible, the elimination of collocated intermediate levels was to occur upon implementation of the Stock Point Automatic Data Processing (ADP) Replacement (SPAR) project at the stock points.

Subsequent analyses, references (2) and (3) of APPENDIX A, identified several cost-effective benefits of having collocated wholesale and intermediate levels. Via reference (4) of APPENDIX A, NAVSUP directed us to quantify the extent to which the retail levels provide better response time to the user than could be provided with wholesale level stocks alone, and to analyze the costs/benefits of the collocated retail and wholesale levels. We examined four major areas: (1) the extent of collocation, (2) the impact on inventory levels from removing collocated intermediate levels, (3) the degradation in Average Customer Wait Time (ACWT) from removing collocated intermediate levels, and (4) the cost to maintain the current ACWT given the removal of collocated intermediate levels.



## II. ANALYSIS

In this section, we discuss the data and definitions used in the study, analyze the extent of collocation over the five year period of 1985 to 1989, the impact of eliminating the collocated retail levels on inventory levels and ACWT, and the cost to maintain ACWT at its current level if collocated retail levels are eliminated.

A. DATA. We used the Master Stock Point Record (MSPR) files which were created approximately the first of January of each year for the five year period of 1985 through 1989 to measure the extent of collocation. The MSPR contains a "snapshot" of the assets and requirements for each item on the date the file was created. We restricted the data universe to 1H and 1R Cognizance Symbols (Cogs) and to the Continental United States (CONUS) Naval Supply Centers (NSCs). Each year's data is assumed typical of levels and assets for that timeframe.

We used the January 1989 MSPR data to measure the impact on inventory levels of eliminating collocation. The underlying premise is that the current collocated wholesale assets typify future average wholesale assets if demand-based intermediate levels were eliminated. In the analysis of this data, we did not address the questions of excess, long supply, and possible redistribution of wholesale material.

We used Requisition Response Time Management Information System (RRTMIS II) data for CY88 (reference (5) of APPENDIX A) to measure the impact on ACWT. The RRTMIS II Total Requisition Response Time (TRRT) report provided response times separately for two customer universes: (1) Shipboard Uniform Automated Data Processing System (SUADPS) (mechanized Afloat) customers and (2) Military Supply and Transportation Evaluation Procedures (MILSTEP) (Ashore) customers. We also used the Point of Entry (POE) Effectiveness statistics from

NAVSUP Publication 295 (annual compilation of NAVSUP Form 1144 Reports, reference (6) of APPENDIX A) in addition to Supply Material Availability (SMA) values provided by the Navy Ships Parts Control Center (SPCC) and the Navy Aviation Supply Office (ASO) as input to the collective ACWT measurement.

B. DEFINITIONS. The universe of items which we evaluated for collocation is the group of all stock point retail items. By definition, retail items include all demand-based and some nondemand-based items. The demand-based items are those which have either a Variable Operating and Safety Level (VOSL) stock level or a positive reorder point (fixed levels). The nondemand-based items include those with a positive quantity in either: (1) Planned Requirements (PRs), (2) Backorders (BOs), or (3) Numerical Stockage Objective (NSO). For each item, we computed assets and requirements to determine whether or not an item had collocated wholesale material, since the current system (Uniform Automated Data Processing System (UADPS)) does not distinguish between wholesale and retail.

A strict definition of collocation follows: "Whenever the total assets exceed the total retail requirements for an item, then that item is defined to be a 'collocated item', and the amount in excess is assumed to be wholesale material." We applied this strict definition both in determining the extent of collocation and the impact of removing collocation. FIGURE 1 shows the requirements as a stack, with the "protected" wholesale requirements at the bottom, retail requirements in the middle portion, and collocated wholesale assets at the top. The total assets equal the sum of the on-hand quantity and the in-process receipts minus the in-process issues. The protected wholesale requirements are the sum of the Fleet Ballistic Missile (FBM) Protection Level (PL) and the Prepositioned War Reserve Material (PWRM). (We assumed that if the intermediate levels were eliminated, the protected wholesale levels would

not be affected.) The nondemand-based intermediate retail requirements are the sum of the PRs and the BOs plus that portion of the NSO quantity which exceeds the Reorder Point (RP). The demand-based intermediate level (which is the candidate for elimination per the GAO recommendation) is the Average Funded Investment Level (AFIL), the sum of the RP and half of the Operating Level (OL). Material due-in was not considered in the analysis because one cannot determine if a due-in is retail or wholesale and dues are often cancelled or otherwise changed.

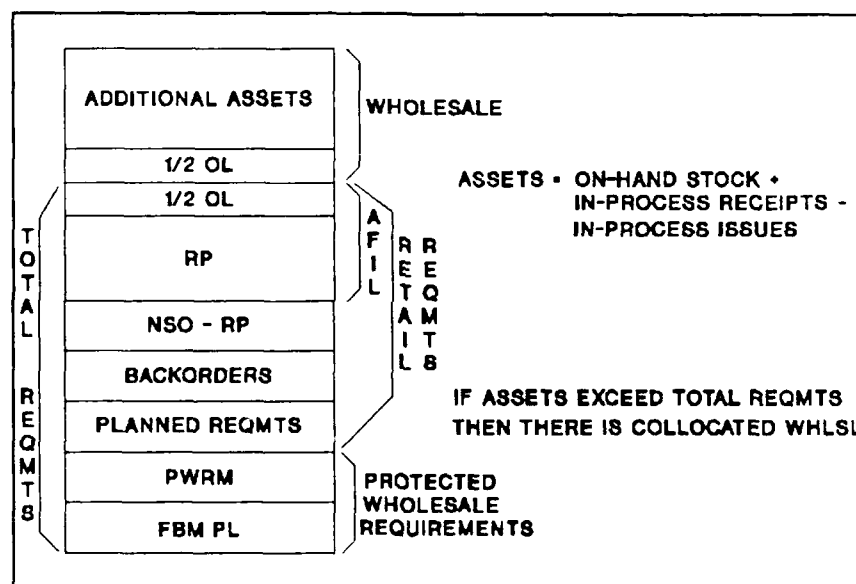


Figure 1 Pictorial View of Assets/Requirements

We believe the strict definition of collocation used in the above computations is too stringent for the following reasons:

It does not consider the maximum retail quantity the activity could have on hand at one time; i.e., the nondemand-based intermediate requirements plus the demand-based Requisitioning Objective (RO) which equals the full OL plus the RP.

. It does not allow for fluctuations in demand and other inventory adjustments which cause minor changes in overall inventory levels and ostensibly yield wholesale assets, when it is not the system's intent to push wholesale assets there.

To make the equation more practical and less stringent, we modified our definition of collocation. Under the modified definition, the RO is used instead of the AFIL in the measurement of retail requirements. The modified definition also includes one year of Annual Demand (AD) as a retail requirement. This is consistent with other NAVSUP policies (i.e., the 9 Cog Budget Stratification Program and the Defense Program for Redistribution of Assets - CONUS Location of Navy Excesses (DEPRA CLONE)) where stock points are not penalized for having up to one year's demand worth of stock above the RO. For purposes of clarity, the formulae for both the strict and modified definitions of collocated wholesale material follow:

STRICT:

$$\text{COLLTD WHLSL MATL} = \text{ASSETS} - [\text{AFIL} + (\text{NSO} - \text{RP}) + \text{BO} + \text{PR} + \text{PWRM} + \text{FBM PL}]$$

MODIFIED:

$$\text{COLLTD WHLSL MATL} = \text{ASSETS} - [\text{RO} + (\text{NSO} - \text{RP}) + \text{BO} + \text{PR} + \text{PWRM} + \text{FBM PL} + \text{AD}]$$

OPNAVINST 4441.12B (reference (7) of APPENDIX A) defines ACWT as "the collective indicator of supply system response time for all customer demands, as measured from requisition generation until receipt of the material by the customer, including requisition submission and receipt take-up times, and is ultimately expressed in terms of hours". The computation depends upon subsidiary performance measures, including TRRT values and effectiveness measures at the consumer, intermediate, and wholesale levels of the supply echelon.

FIGURE 2 shows the "decision tree" definition of ACWT. The ACWT computation is the sum of four products. Each product can be expressed as the probability of a requisition following that path, multiplied by the corresponding TRRT value. The abbreviated notation in FIGURE 2 is defined as follows:

- P(C) - Probability the material is available at the consumer level
- P(I) - Probability the material is available at the intermediate level
- P(W) - Probability the material is available at the wholesale level
- CRT(A) - TRRT for material obtained at the consumer level
- IRT(A) - TRRT for Point of Entry Immediate Issues
- WRT(A) - TRRT for Referral Immediate Issues
- WRT(NA) - TRRT for Backorders

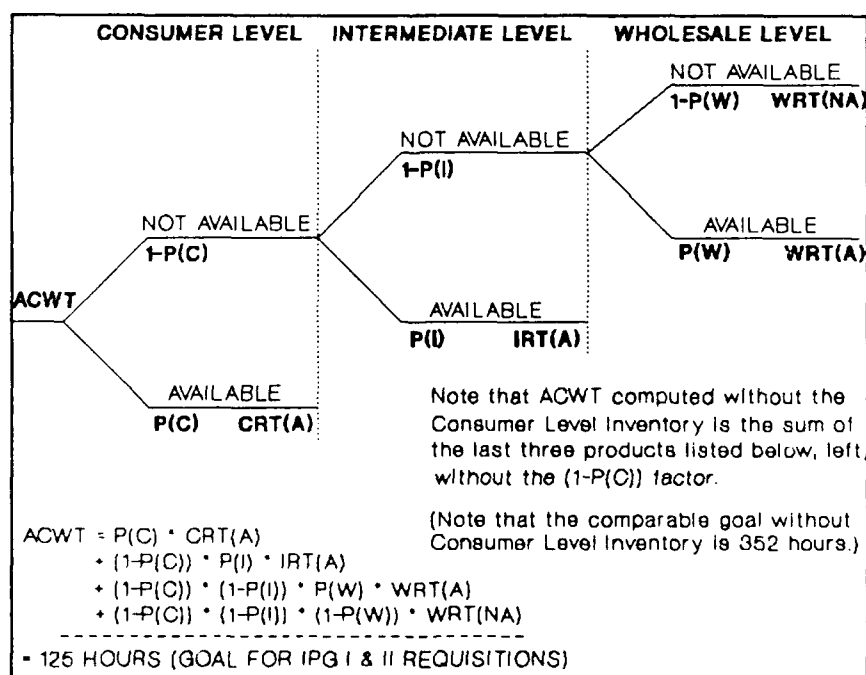


Figure 2 Decision Tree for ACWT Computations

C. EXTENT OF COLLOCATION. We applied the formula in FIGURE 1 (strict definition of collocated wholesale assets) to the universe of retail items for each of the five years used in the study. We used the unit price of each item, as available from the MSPR files for each year, without attempting to estimate an inflationary impact to standardize prices over the five year period. We did not track individual items from year to year to determine the constancy of collocation. This section shows findings across the five years used in the study. It analyzes the extent of collocation for all retail items carried and the dollar value of total assets, broken down according to protected wholesale assets, retail assets, and collocated wholesale assets, for collocated items at all the activities used in the study. We repeated the computations for 1H Cog and 1R Cog at each NSC considered. APPENDIX B contains these graphs for the individual activities. Also included in this section is a discussion of the anomalies which skewed the results shown in the graphs. These anomalies affect the inventory in two ways: either they cause an increase in the collocated wholesale assets for retail items, or they cause a decrease in the number of retail items, thereby possibly creating long supply and excess for these items in the wholesale system. The findings are presented below by Cog.

1. 1H Cog. FIGURE 3 shows that the total number of 1H retail items declined by 1.7K (3%) over the last five years. However, the total number of 1H collocated items increased by 4.8K (12%), with a decrease of 6.5K (29%) in 1H noncollocated items.

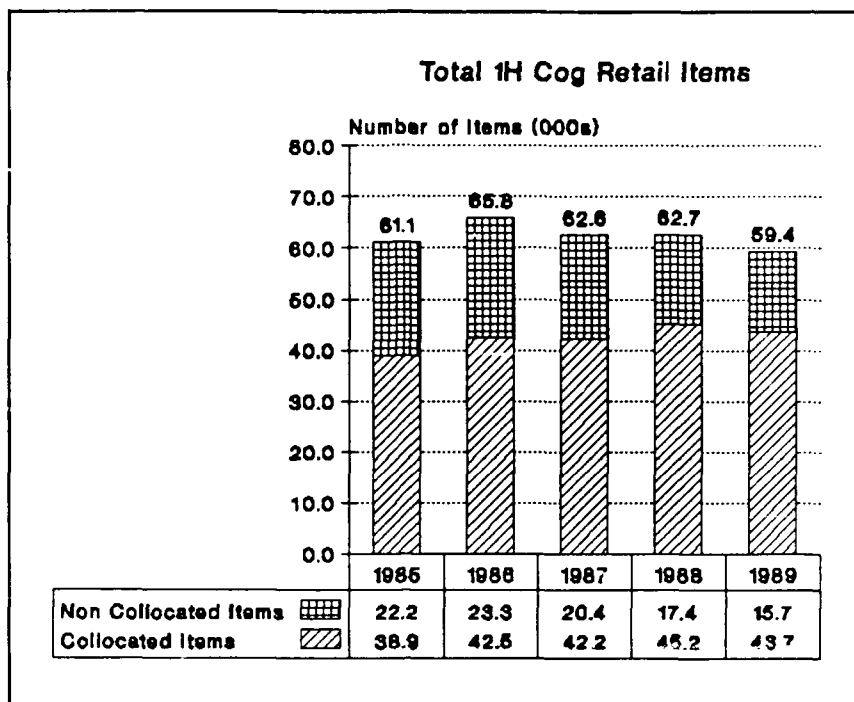


Figure 3 Total 1H Cog Retail Items

FIGURE 4 shows the 1H collocated retail items' priced-out asset positions for protected wholesale, retail, and collocated wholesale assets. The protected wholesale assets have varied greatly from year to year and are down overall by \$6.5M (44%). Retail assets were fairly constant until January 1989, when they dropped \$6.5M (26%). Collocated wholesale assets steadily increased through January 1988 but dropped \$77.1M (18%) in January 1989; overall the increase was \$30.1M (9%).

Some of the fluctuations that appear both above and in the APPENDIX B graphs are caused by anomalies in the data. We noted a decrease in 1H protected wholesale assets for January 1989 at NSC Charleston (\$3.8M) and at NSC Puget Sound (\$0.5M). This drop was caused by a decrease in the dollar value of requirements for FBM PLs. A problem in the transmittal of reservation quantities to NSC Norfolk resulted in the January 1988 protected wholesale assets being only \$0.5M compared to \$3.9M in January 1989. However, the major

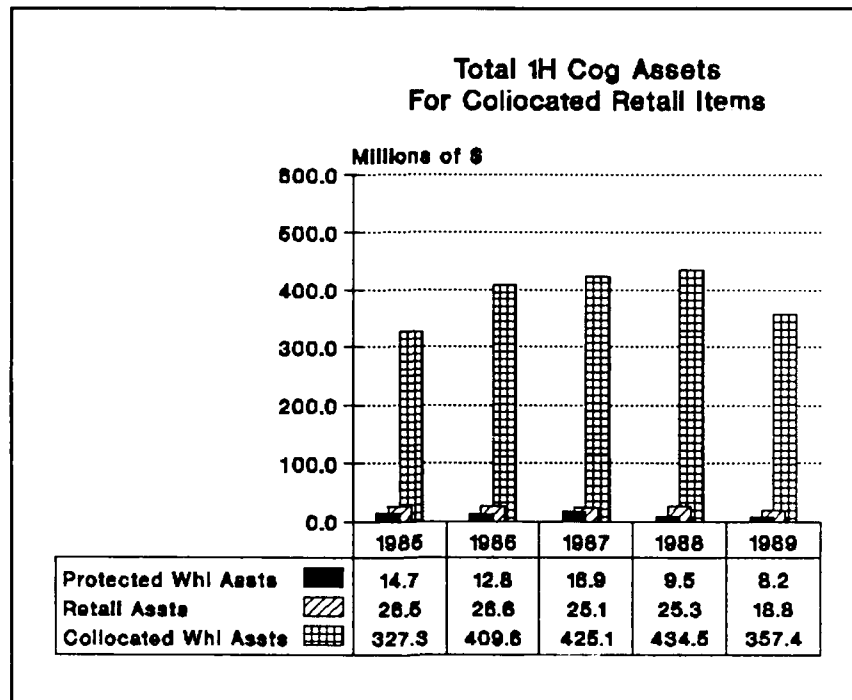


Figure 4 Total 1H Cog Assets

cause of anomalies in the 1H data is the decrease in demand for retail items. TABLE I shows the projected annual demand for VOSL items, as extracted from the Management Criteria Listings (MCLs) received by SPCC from the activities for the five years studied. The definition of VOSL items is synonymous with demand-based retail items. Also shown is the number of VOSL items as of 1 January 1985 and 1989. The decrease in annual demand ranges from 26% at NSC Puget Sound to 57% at NSC Oakland. This decrease resulted in a loss of VOSL items at NSCs Jacksonville (36%) and Oakland (19%). However, the decrease in annual demand did not result in a significant decrease in VOSL items at the other NSCs. All other activities remained relatively constant in the number of VOSL items; in fact, NSC Puget Sound had a 30% increase in VOSL items.



TABLE I  
1H Cog VOSL Items

	FORECASTED VALUE OF ANNUAL DEMAND					
	CHASN	JAX	NORVA	OAK	TUGET	SAN D.
JAN 1985	\$41.7M	\$6.9M	\$54.4M	\$11.9M	\$15.0M	\$28.9M
JAN 1986	\$46.0M	\$7.2M	\$53.9M	\$12.1M	\$21.0M	\$29.3M
JAN 1987	\$41.6M	\$7.0M	\$53.1M	\$10.0M	\$18.4M	\$27.6M
JAN 1988	\$37.2M	\$5.6M	\$47.3M	\$ 9.1M	\$17.9M	\$24.5M
JAN 1989	\$30.1M	\$3.5M	\$31.5M	\$ 5.1M	\$11.1M	\$18.8M

	# OF VOSL ITEMS					
JAN 1985	12,535	3,333	15,148	5,502	5,359	9,370
JAN 1989	12,602	2,122	14,808	4,463	6,985	8,923

2. 1R Cog. FIGURE 5 shows that the total number of 1R retail items has declined by 8.6K (27%) over the last five years. Concurrently, the total number of 1R collocated items has decreased 3.8K (19%), with a decrease of 5.0K (41%) in 1R noncollocated items.

FIGURE 6 shows the 1R collocated retail items' priced-out asset positions for protected wholesale, retail, and collocated wholesale assets. The protected wholesale assets varied greatly from year to year and are down \$5.0M (44%) overall. Retail assets had increased until January 1987. They have since dropped (January 1989) to approximately the January 1985 retail asset position. Except for January 1986, collocated wholesale assets steadily increased through January 1988 but dropped \$5.8M (1%) in January 1989; however, the overall increase was \$93.3M (20%).

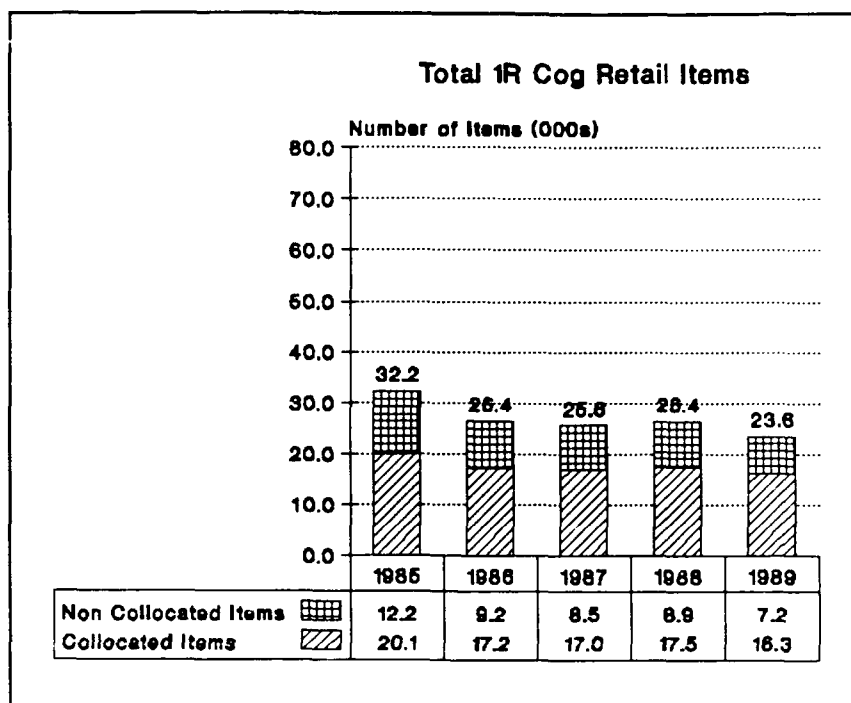


Figure 5 Total 1R Cog Retail Items

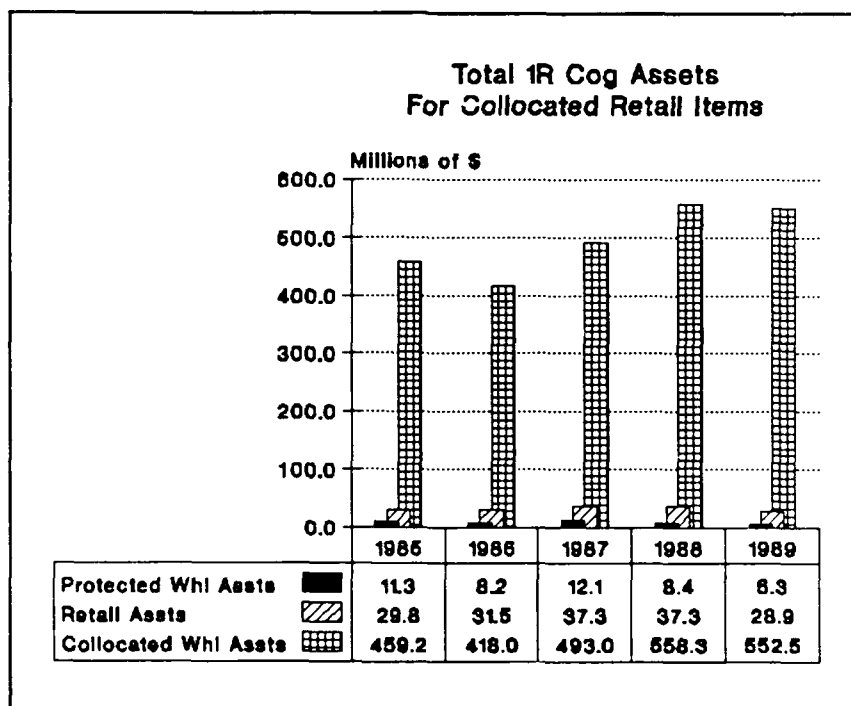


Figure 6 Total 1R Cog Assets

Some of the fluctuations that appear both in Figures 5 and 6 and in the APPENDIX B graphs are caused by anomalies in the data. The fluctuation in 1R protected wholesale assets is caused by the Prepositioned War Reserve churn issue which the Navy is currently investigating. The major cause of anomalies in the 1R data is the decrease both in demand and in the number of retail items at NSCs Norfolk and Oakland. Because 1 January 1R Cog MCL data was not available in all cases, we could not construct a 1R Cog Table similar to TABLE I. However, we could make some observations for available MCL data. Based on MCL data received by ASO, the projected annual demand for NSC Norfolk dropped 67% (\$70.1M) between January 1985 and January 1989; the number of VOSL items dropped by 55% (5.3K) in the same period. An unquantifiable portion of this decrease was caused by the Uniform Automated Data Processing System - Stock Points (UADPS-SP) program change made in September 1984 which allowed only Naval Aviation Depots (NADEPs) to requisition 1R Cog material directly from a stock point. At NSC Oakland, the projected annual demand dropped 31% (\$21.3M) between September 1987 and April 1989, with the largest drop in demand being \$13.6M between September 1988 and April 1989. The number of VOSL items experienced the same type decline; i.e., 21% (1.2K) decrease between September 1987 and April 1989 with the largest decrease, 0.8K, occurring between September 1988 and April 1989.

D. IMPACT ON INTERMEDIATE INVENTORY LEVELS. We applied both our strict definition of collocated wholesale assets (formula in FIGURE 1) and our modified formula for collocated wholesale assets to the universe of retail items as of 1 January 1989. We separated the retail items into four categories: (1) nondemand-based collocated items, (2) demand-based collocated items, (3) nondemand-based noncollocated items, and (4) demand-based noncollocated items. We compared each of these categories to the retail item total for (1) number

of items, (2) total assets, (3) protected wholesale assets, (4) retail requirements, (5) total requirements, and (6) collocated wholesale assets. We repeated the comparisons for each NSC considered and for each of 1H and 1R Cogs. APPENDIX C contains the results of the above analysis by activity within Cog group.

Before looking at the resulting inventory reductions, we first discuss another issue which impacts these inventory reductions. Current Navy policy states that retail items should have an overall Average Inventory Level (AIL) of 2.5 months; this AIL is based on three months OL, one month Safety Level (SL), and one month Lead Time (LT). Current Ships Operation Support Inventory (OSI) policy (reference (8) of APPENDIX A) states that inventory levels for stock points with wholesale stock should not include leadtime or safety level, thus consisting of only the three months OL (1.5 months AIL), while stock points without wholesale stock should have an AIL of 2.5 months. Since VOSL was chosen as the vehicle to implement OSI for 1H Cog, some adjustments were required to conform to the above policies. Computations used in the VOSL model do not permit the elimination of leadtimes and safety levels. To compensate for this and still conform to OSI policy, the AIL was reduced to 1.5 months; however, not all the dollars were allocated to OL. The distribution of stock levels became two months of OL and 0.5 month SL for all items without regard to collocation. Thus, by policy definition, the elimination of collocated retail stock levels should allow for an increase in AIL for non-collocated retail items to 2.5 months AIL. This will occur for VOSL items at

all NSCs holding 1R Cog material and at all NSCs holding 1H Cog material except for NSCs Jacksonville and Puget Sound, which are already at 2.5 months AIL. (At the time of the reference (b) policy issuance, these two activities were designated as minor wholesale stocking sites by SPCC.) We determined this cost and the cost to fund that portion of the NSO currently funded by retail levels (NSO less than or equal to RP) as costs the Navy would still incur if collocated retail stock levels were eliminated.

1. 1H Cog. TABLE II shows the extent of collocation for demand and nondemand-based retail items for 1H Cog. It shows that demand-based collocated items make up a large portion of the inventory. Over 70% of the retail item National Item Identification Number (NIINs), 95% of the total assets, 72% of the protected wholesale requirements, 60% of the retail requirements, 63% of the total requirements, and 95% of the collocated wholesale assets reside in demand-based collocated retail 1H Cog items. The table also shows that most of the 1H Cog assets are wholesale assets and that retail requirements make up only 8% of the total 1H Cog assets.

TABLE III shows the impact of our modified definition of collocation on the 1H Cog inventory in terms of number of retail items, total assets and collocated wholesale assets. The modified definition shifts some demand-based items from being collocated to being noncollocated. The demand-based collocated category has a decrease in retail items of 11.5K (28%), a decrease in total assets of \$19.5M (5%), and a decrease in collocated wholesale assets of \$55.6M (16%). FIGURE 7 graphically compares the dollar value of collocated wholesale assets under the strict and modified definitions. All future 1H Cog analyses will use the more realistic modified definition of collocation.

TABLE II

1H Cog - Jan 1989  
Collocation of Inventory  
Strict Definition

	NonDmd-Bsd NonColltd	Dmd-Bsd NonColltd	NonDmd-Bsd Colltd	Dmd-Bsd Colltd	Total
Retail NIINs	1.2K	14.5K	1.8K	41.9K	59.4K
Total Assets	\$0.6M	\$3.1M	\$15.9M	\$368.4M	\$388.0M
Protected Wholesale Requirements	\$0.1M	\$2.6M	\$0.3M	\$7.9M	\$10.9M
Retail Requirements	\$1.0M	\$10.1M	\$0.7M	\$18.1M	\$29.8M
Total Requirements	\$1.1M	\$12.7M	\$1.0M	\$26.0M	\$40.7M
Collocated Whls Assets	---	---	\$14.9M	\$342.4M	\$357.4M
NOTE: NonDmd-Bsd NonColltd - NonDemand-Based NonCollocated Items Dmd-Bsd NonColltd - Demand-Based NonCollocated Items NonDmd-Bsd Colltd - NonDemand-Based Collocated Items Dmd-Bsd Colltd - Demand-Based Collocated Items					

TABLE III

1H Cog - Jan 1989  
Collocation of Inventory  
Modified Definition

	NonDmd-Bsd NonColltd	Dmd-Bsd NonColltd	NonDmd-Bsd Colltd	Dmd-Bsd Colltd	Total
Retail NIINs	1.2K	26.0K	1.8K	30.4K	59.4K
Total Assets	\$0.6M	\$22.6M	\$15.9M	\$348.9M	\$388.0M
Collocated Whls Assets	---	---	\$14.9M	\$286.8M	\$301.7M
NOTE: NonDmd-Bsd NonColltd - NonDemand-Based NonCollocated Items Dmd-Bsd NonColltd - Demand-Based NonCollocated Items NonDmd-Bsd Colltd - NonDemand-Based Collocated Items Dmd-Bsd Colltd - Demand-Based Collocated Items					

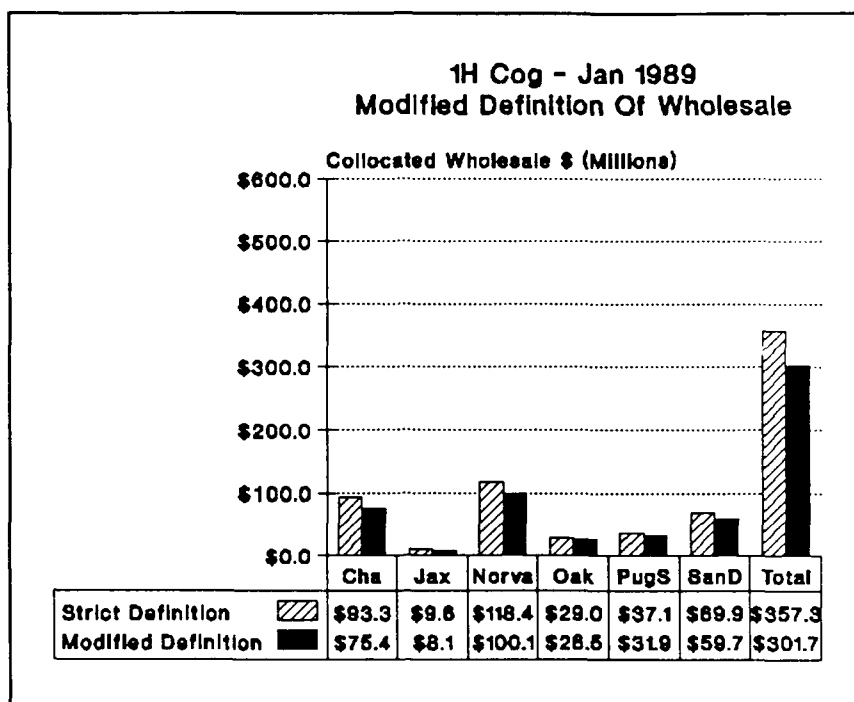


Figure 7 1H Cog Modified Definition of Wholesale

TABLE IV shows the inventory reduction in terms of dollars invested in stock levels if all retail levels are eliminated or if retail levels are eliminated for only collocated items. Although GAO recommended eliminating only the collocated retail levels, we included the savings from total elimination of retail levels since, for purposes of implementation, it would be difficult (if not impossible) to segregate collocated retail levels from other retail levels. If all retail stock levels are deleted, the dollar value of inventory reduction for 1H Cog is \$26.4M in AFIL\$ (\$36.0M in RO\$). If intermediate levels are eliminated for collocated retail items only, the dollar value of inventory reduction is \$10.9M in AFIL\$ (\$14.8M in RO\$). Please note that the Additive portion (ADD\$) is the portion of the NSO\$ which is currently funded as part of the retail level; elimination of the retail levels would require additional funding for this portion of the NSO\$ (i.e., the NSO\$-ADD\$).

TABLE IV  
Inventory Reduction  
1H COG

ACTIVITY	ELIMINATE ALL RETAIL LEVELS				ELIMINATE COLLOCATED RETAIL LEVELS			
	AFIL\$	RO\$	NSO\$	ADD\$	AFIL\$	RO\$	NSO\$	ADD\$
CHARLESTON	7,876K	10,348K	67K	47K	3,309K	4,200K	34K	18K
JACKSONVILLE	1,032K	1,433K	966K	784K	348K	490K	136K	62K
NORFOLK	7,744K	10,690K	1,069K	504K	3,424K	4,802K	421K	97K
OAKLAND	1,215K	1,616K	85K	103K	601K	793K	17K	7K
PUGET SOUND	3,756K	5,513K	322K	285K	1,228K	1,804K	32K	19K
SAN DIEGO	4,817K	6,419K	1,355K	864K	2,027K	2,765K	457K	176K
TOTAL	26,443K	36,022K	3,866K	2,588K	10,939K	14,857K	1,099K	380K

NOTE: ADD\$ = Portion of NSO above RP

TABLE V shows the cost of eliminating the retail stock levels for 1H Cog collocated retail items under our modified definition of collocation. Included in the table is the cost to increase the AIL for noncollocated retail 1H items to 2.5 months, and the cost to fund the full NSO for collocated items. The cost to AIL is the average amount of material which is on hand, while the cost to RO is the cost which would be experienced if every item were bought today using current replenishment rules. The cost to fund the NSO for collocated retail 1H items is the cost of the material which is currently covered by retail levels (NSO less than or equal to RP). TABLE V shows that the overall inventory cost to eliminate collocated 1H retail item stock levels, increase the AIL to 2.5 months AIL, and fully fund the NSOs will be \$5.3M.



TABLE V

1H Cog Cost to Eliminate Collocated  
Retail Stock

	COST TO AIL	COST TO RO
INCREASE IN AIL FOR NONCOLLOCATED ITEMS:		
NSC CHARLESTON	\$1,957.4K	\$2,905.6K
NSC NORFOLK	1,673.1K	2,546.5K
NSC OAKLAND	145.4K	205.3K
NSC SAN DIEGO	<u>788.4K</u>	<u>1,175.7K</u>
SUBTOTAL	\$4,564.3K	\$6,833.1K
COST TO FUND NONSUPPORTED NSO:		
NSC CHARLESTON	\$ 15.3K	
NSC JACKSONVILLE	74.4K	
NSC NORFOLK	324.3K	
NSC OAKLAND	10.6K	
NSC PUGET SOUND	13.3K	
NSC SAN DIEGO	<u>280.8K</u>	
SUBTOTAL	\$718.7K	\$718.7K
TOTAL	\$5,283.0K	\$7,551.8K

To summarize: If we eliminate retail stock levels for 1H Cog collocated retail items, we must increase the AIL for the remaining items to 2.5 months. Thus, the inventory reduction for the elimination of collocated retail stock levels is \$10.9M. But the cost to increase the AIL for the remaining items equals \$5.3M, yielding a net 1H Cog inventory reduction of \$5.6M.

2. 1R Cog. TABLE VI shows the extent of collocation for demand-based and nondemand-based retail items for 1R Cog. It shows that the demand-based collocated items make up a large portion of the inventory. Over 68% of the retail NIINs, 98% of the total assets, 68% of the protected wholesale requirements, 48% of the retail requirements, 51% of the total requirements, and 99% of the collocated wholesale assets are for demand-based collocated retail

1R Cog items. TABLE VI also shows most 1R Cog assets are wholesale assets and that retail requirements make up only 10% of the total 1R Cog assets.

TABLE VI  
1R Cog - Jan 1989  
Collocation of Inventory  
Strict Definition

	NonDmd-Bsd NonColltd	Dmd-Bsd NonColltd	NonDmd-Bsd Colltd	Dmd-Bsd Colltd	Total
Retail NIINs	0.4K	6.9K	0.3K	16.1K	23.6K
Total Assets	\$0.2M	\$4.9M	\$4.5M	\$583.2M	\$592.9M
Protected Wholesale Requirements	\$0.0M	\$2.9M	\$0.0M	\$6.3M	\$9.2M
Retail Requirements	\$2.0M	\$28.3M	\$0.3M	\$28.6M	\$59.1M
Total Requirements	\$2.0M	\$31.2M	\$0.3M	\$34.8M	\$68.4M
Collocated Whls Assets	---	---	\$4.1M	\$548.4M	\$552.5M
NOTE: NonDmd-Bsd NonColltd - NonDemand-Based NonCollocated Items Dmd-Bsd NonColltd - Demand-Based NonCollocated Items NonDmd-Bsd Colltd - NonDemand-Based Collocated Items Dmd-Bsd Colltd - Demand-Based Collocated Items					

TABLE VII shows the impact of the modified definition of collocation in the 1R Cog inventory in terms of number of retail items, total assets and collocated wholesale assets is shown. The modified definition shifts demand-based items from being collocated to being noncollocated. The demand-based collocated category has a decrease in retail items of 4.1K (25%), a decrease in total assets of \$28.1M (5%), and a decrease in collocated wholesale assets of \$97.0M (18%). FIGURE 8 graphically compares dollar values of collocated wholesale assets under the strict and modified definitions. All future 1R Cog analyses will use the more realistic modified definition of collocation.

TABLE VII

1R Cog - Jan 1989  
Collocation of Inventory  
Modified Definition

	NonDmd-Bsd NonColltd	Dmd-Bsd NonColltd	NonDmd-Bsd Colltd	Dmd-Bsd Colltd	Total
Retail NIINs	0.4K	10.9K	0.3K	12.0K	23.6K
Total Assets	\$0.2M	\$33.1M	\$4.5M	\$555.1M	\$592.9M
Collocated Whls Assets	---	---	\$4.1M	\$451.4M	\$455.5M

NOTE: NonDmd-Bsd NonColltd - NonDemand-Based NonCollocated Items  
Dmd-Bsd NonColltd - Demand-Based NonCollocated Items  
NonDmd-Bsd Colltd - NonDemand-Based Collocated Items  
Dmd-Bsd Colltd - Demand-Based Collocated Items

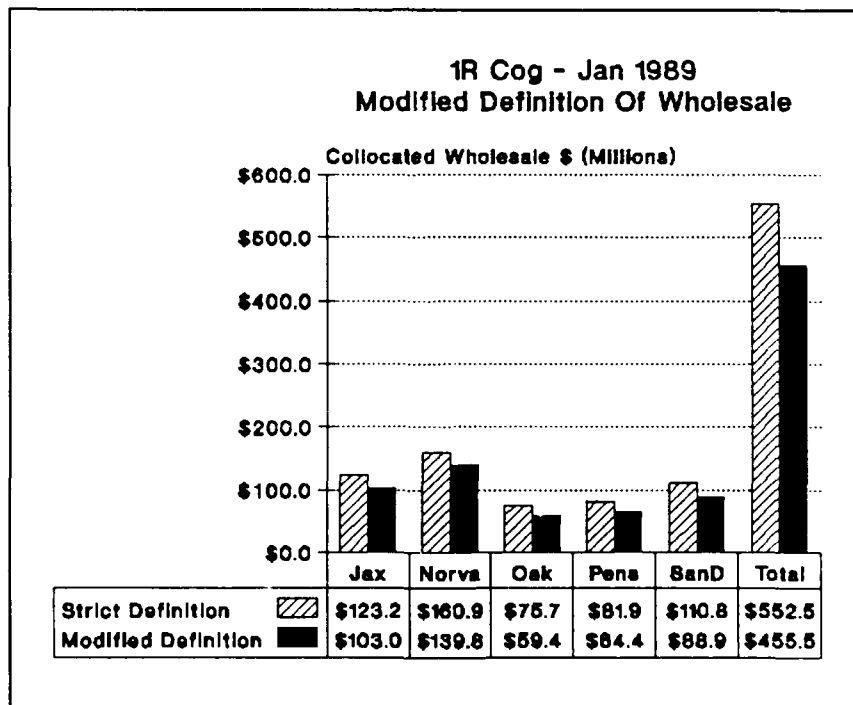


Figure 8 1R Cog Modified Definition of Wholesale

TABLE VIII shows the inventory reduction in terms of dollars invested in 1R Cog retail stock levels if all retail stock levels are eliminated or if retail levels for only collocated items are eliminated. Although GAO recommended eliminating only the collocated retail levels, we included the savings from total elimination of retail levels since, for purposes of implementation, it would be difficult (if not impossible) to segregate collocated retail levels from other retail levels. If all retail stock levels are eliminated, the dollar value of the reduction in inventory for 1R Cog is \$55.7M in AFIL\$ (\$75.4M in RO\$). If stock levels are eliminated only for collocated retail items, the dollar value of the reduction in inventory is \$18.8M in AFIL\$ (\$26.6M in RO\$). Please note that the ADD\$ is the portion of the NSO\$ which is currently funded as part of the retail level; eliminating retail levels would require additional funding for this portion of the NSO\$.

TABLE VIII  
Inventory Reduction  
1R COG

ACTIVITY	ALL RETAIL ITEMS				COLLOCATED RETAIL ITEMS			
	AFIL\$	RO\$	NSO\$	ADD\$	AFIL\$	RO\$	NSO\$	ADD\$
JACKSONVILLE	10,053K	13,691K	17K	17K	3,535K	5,034K	0K	0K
NORFOLK	9,748K	14,130K	140K	124K	4,445K	6,664K	43K	29K
OAKLAND	14,763K	18,503K	38K	29K	3,832K	5,024K	9K	0K
PENSACOLA	9,951K	13,340K	729K	714K	3,303K	4,501K	51K	47K
SAN DIEGO	11,189K	15,757K	825K	630K	3,651K	5,334K	346K	281K
TOTAL	55,707K	75,423K	1,751K	1,515K	18,768K	26,558K	452K	358K
NOTE: ADD\$ - Portion of NSO above RP								

TABLE IX contains the cost of eliminating the stock levels for 1R Cog collocated retail items under our modified definition of collocation. TABLE IX shows that the overall inventory cost to eliminate collocated 1R retail item stock levels, increase the AIL to 2.5 months, and fully fund the NSOs will be \$13.0M.

TABLE IX  
1R Cog Cost to Eliminate Collocated  
Retail Stock

	COST TO AIL	COST TO RO
INCREASE IN AIL FOR NONCOLLOCATED ITEMS:		
NSC JACKSONVILLE	\$3,115.7K	\$4,830.9K
NSC NORFOLK	590.8K	890.2K
NSC OAKLAND	4,287.7K	6,307.1K
NSC PENSACOLA	1,839.2K	2,909.2K
NSC SAN DIEGO	<u>3,032.7K</u>	<u>4,654.3K</u>
SUBTOTAL	\$12,866.1K	\$19,591.7K
COST TO FUND NONSUPPORTED NSO:		
NSC JACKSONVILLE	\$ 0.0K	
NSC NORFOLK	14.4K	
NSC OAKLAND	9.3K	
NSC PENSACOLA	4.7K	
NSC SAN DIEGO	<u>615.7K</u>	
SUBTOTAL	\$ 94.1K	\$ 94.1K
TOTAL	\$12,960.2K	\$19,685.8K

To summarize: If we eliminate retail stock levels for 1R Cog collocated retail items, we must increase the AIL for the remaining items to 2.5 months. Thus, the inventory reduction for the elimination of collocated retail stock levels is \$18.8M. But the cost to increase the AIL for the remaining items equals \$13.0M, yielding a net 1R Cog inventory reduction of \$5.8M.

E. DEGRADATION IN ACWT. We used the "decision tree" definition of ACWT given in Section II.B (Definitions) as the basis for measuring overall customer wait time. First, we computed ACWT based upon current RRTMIS II response times (reference (5) of APPENDIX A), current POE values (reference (6) of APPENDIX A), and current SMA statistics to establish a baseline for customer support. Next, we computed the predicted ACWT after the total elimination of retail levels, using the expected POE and SMA values. Finally, we applied Requisition Weighting Factors (RWFs) to the computed ACWT values in order to compute the expected ACWT after the elimination of only the collocated retail levels. The result of these calculations provided us with three scenarios for measuring the impact on ACWT: (1) current or baseline ACWT, (2) "worst case" ACWT, resulting from the total elimination of all 1H and 1R Cog retail levels at the NSCs, and (3) expected ACWT after the elimination of only the collocated 1H and 1R Cog retail levels at the NSCs (per the GAO recommendation). We considered the "worst case" scenario, since, for the purpose of implementation, it would be difficult (if not impossible) to segregate collocated retail from other retail material. We then plotted all ACWT results in comparative bar charts, with each chart showing clusters of three bars corresponding to the ACWT for the three scenarios.

The ACWT calculations depend upon several subsidiary performance measures. One measure that we obtained is the probability that a requisition can be filled at the intermediate level, given that it cannot be filled at the consumer level. We denote this probability in the "decision tree" as  $P(I)$ , known as the POE Effectiveness. We obtained the current POE statistics (FY88) and

expected POE statistics (FY81, the year prior to the establishment of retail levels) from reference (6) of APPENDIX A. The FY81 POE values represent the time period prior to the implementation of Retail Inventory and Management Stockage Policy (RIMSTOP), which established retail levels at the NSCs. The POE statistics applied in this study are the annual compilation of NAVSUP Form 1144 Reports from the stock points, and all of the values are reprinted in TABLE I of APPENDIX D.

A second subsidiary performance measure we obtained is the probability that a requisition can be filled at the wholesale level, given that it cannot be filled at the intermediate level. We denote this probability in the "decision tree" as  $P(W)$ , also known as the Referral Effectiveness (RE), or the gross availability at the wholesale level. The Navy does not normally track or monitor the RE; however, the RE is a function of the POE effectiveness and the SMA. We used the following formula to compute RE:  $RE = (SMA - POE) / (1.0 - POE)$ . The SMA values and computed RE statistics which we applied to the ACWT computations appear in TABLE II of APPENDIX D.

A third set of statistics we calculated for use in ACWT computations comprises the "weights" which we applied to the "worst case" ACWT and to the baseline ACWT in order to compute the expected ACWT after the elimination of only the collocated retail levels. These weights are RWF and  $(1.0 - RWF)$ , for the "worst case" ACWT and baseline ACWT, respectively. We used the January 1989 MSPR data to compute the RWFs, which are "the percent of all requisitions which are for collocated items". TABLE III of APPENDIX D contains the computed RWF values for each NSC and the NSC Total, for each of 1H and 1R Cogs.

The last group of subsidiary performance measures we used for ACWT computations includes the Consumer Response Time (Available) (CRT(A)), Wholesale Response Time (Available) (WRT(A)) and Wholesale Response Time (Not Available) (WRT(NA)) response times as shown in the "decision tree". We measured total requisition response time by computing three descriptive statistics (provided in TABLES IV through VI of APPENDIX D): mean, median, and 75th percentile numbers of days. We later converted these TRRT values to hours in the collective ACWT calculation. The computed TRRT values may be underestimated, due to three filters which the RRIMIS 11 programs apply. That is, RRTMIS discarded all receipts with any of the following conditions: (1) submission time in excess of 98 days, (2) transportation time in excess of 99 days, or (3) Transportation Hold Code of "L" (delay requested or concurred in by consignee).

We repeated the ACWT "decision tree" calculations for different data stratifications as follows: (1) for 1H Cog and for 1R Cog, (2) for each NSC and for all NSCs, (3) for Issue Priority Groups (IPG) I + II only, and for all IPGs, (4) for SUADPS and non-SUADPS customer universes, and (5) for each of the mean, median, and 75th percentile TRRT values. Our approach in measuring ACWT depends upon certain assumptions: (1) there would be no change to current requisitioning channels if intermediate levels were reduced, (2) the individual response times of the legs of the "decision tree" would not change after the removal of intermediate level stock, and (3) the response times for referral immediate issues and for backorders (WRT(A) and WRT(NA) values) are system values for requisitions which cannot be satisfied at the POE activity.



A special consideration for ACWT measurement is the "lock-out" policy for 1R Cog requisitions which stipulates that only NADEP customers may requisition 1R Cog material through an NSC: all others go directly through ASO. Figures 1 and 2 of APPENDIX D are two examples of the ACWT computations ("decision tree" paths) which illustrate the application of probabilities and response times, in addition to the RWF weighting procedure. The first example is for 1H Cog material, showing all three echelons of supply. The second example depicts the 1R Cog "lock-out", which shows that the intermediate echelon is not present within the ACWT computation for non-NADEP customers.

We measured the impact on ACWT for all three scenarios: baseline, after eliminating collocated retail only, and "worst case". We examined the results from two perspectives: (1) overall ACWT including the consumer echelon and (2) ACWT for requisitions which could not be satisfied at the consumer echelon of the Navy supply system. Our reason for considering both perspectives is that RRTMIS II data does not measure response times for material which is available at the consumer level. Therefore, in the overall ACWT we assumed material was available at the consumer echelon within two hours, 65% of the time. To remove these assumptions, we also computed ACWT without the consumer level. Per reference (7) of APPENDIX A, the ACWT goal for IPG I and II demands is 125 hours. The comparable goal from the vantage point of only those IPG I and II requisitions which enter the intermediate level activity is 352 hours.

We provide the results showing the impact on ACWT in several sections. The "system" results, which represent the total across all NSCs, follow within sections 1 and 2. We discuss the individual NSC results in section 3 and provide the corresponding charts in APPENDIX D. Finally, we summarize the impact on ACWT in section 4.

1. 1H Cog System Results. FIGURE 9 displays the 75th percentile ACWT values (IPG I & II only) for both SUADPS and non-SUADPS customers, considered from two perspectives: computed with and without the consumer level of inventory. The results from the first perspective show that currently (baseline), 75 percent of all 1H Cog requests are filled within 594 hours for SUADPS customers and within 434 hours for non-SUADPS customers. With the elimination of retail for collocated items only, these ACWT values would increase to 717 hours (up 21%) and 559 hours (up 29%), respectively. Furthermore, with the total elimination of all retail levels, these ACWT values would escalate to 766 hours (up 29%) and 609 hours (up 40%), respectively.

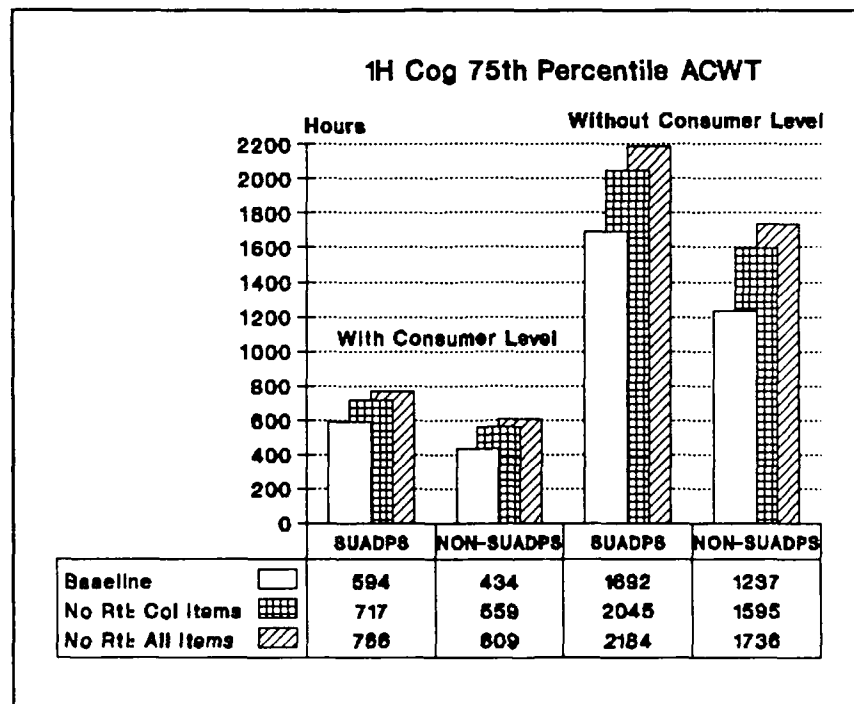


Figure 9 1H Cog 75th Percentile ACWT

FIGURE 9 also shows the comparable ACWT values for 1H material requests not satisfied at the consumer level. Current baseline 75th percentile ACWT values for 1H requisitions not satisfied at the consumer level are 1692 hours for SUADPS customers and 1237 hours for non-SUADPS customers. With the partial elimination of retail (only for collocated items), this 75th percentile ACWT will increase to 2045 hours and 1595 hours, respectively. With the total elimination of all retail, it would increase to 2184 hours and 1736 hours, respectively. The relative percentage increase for each statistic is the same as when including the consumer level in ACWT.

FIGURE 10 shows the same information as FIGURE 9 except that all ACWT values represent the median, or 50th percentile. The baseline data can be interpreted as follows: half of all 1H material requests from SUADPS customers can be satisfied within 363 hours and half cannot. For non-SUADPS customers, the baseline median ACWT is 256 hours. Note that the goal for ACWT is 125 hours, which currently is met by fewer than half of all requests.

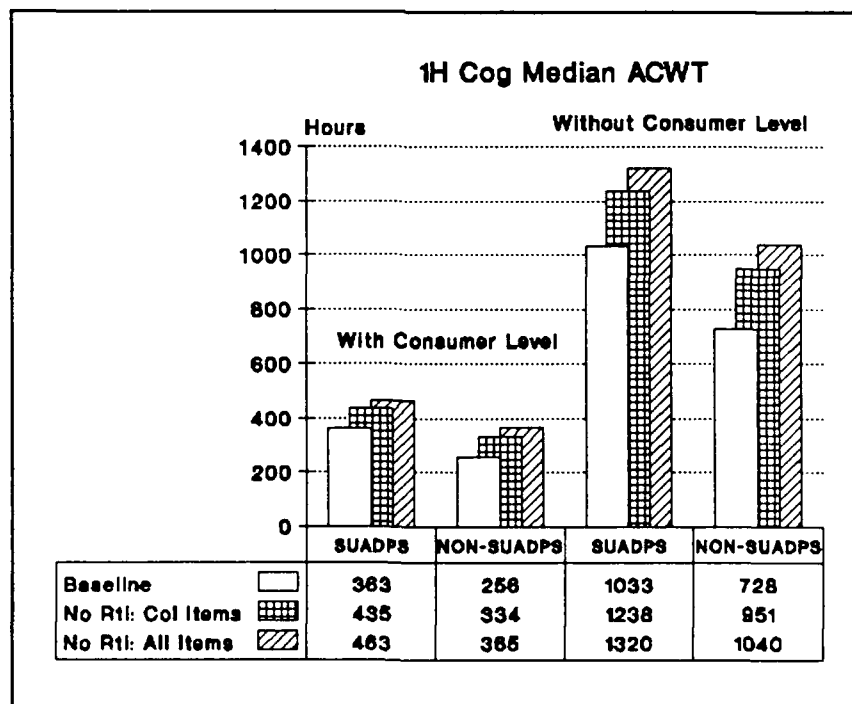


Figure 10 1H Cog Median ACWT

TABLE X summarizes the expected percentage increase in ACWT for 1R Cog material after eliminating all or part of 1R retail levels. Note that the percentage increase is approximately the same for ACWT computed from either perspective (with or without the inclusion of the consumer level of inventory). Furthermore, there is little variation in the percentage values for the three statistics: mean, median, and 75th percentile. The key 1R Cog results are evident from TABLE X: (1) the elimination of only the collocated 1R Cog retail levels would result in a 18% to a 31% increase in ACWT, and (2) the elimination of all 1R Cog retail levels would result in a 23% to 43% increase in ACWT.

TABLE X

1R Cog System Summary of Percentage Increase in ACWT  
after Elimination of Collocated/All Retail Levels

	ACWT W/CONSUMER LEVEL		ACWT W/O CONSUMER LEVEL	
	SUADPS	NON-SUADPS	SUADPS	NON-SUADPS
ELIMINATION OF COLL RET				
75TH PERCENTILE	21%	29%	21%	29%
MEDIAN	20%	30%	20%	31%
MEAN	18%	28%	18%	28%
ELIMINATION OF ALL RET				
75TH PERCENTILE	29%	40%	29%	40%
MEDIAN	28%	43%	28%	43%
MEAN	25%	23%	25%	39%

2. 1R Cog System Results. Due to the "lock-out" for requisitioners of 1R Cog material, the only non-SUADPS customers we considered are those which may requisition through an NSC; i.e., the NADEPs. The SUADPS customers directly requisition 1R Cog material through ASO, and, accordingly, their "decision tree" computations of ACWT do not include the intermediate level activity.

However, the removal of any or all retail levels at the intermediate level activity impacts adversely on expected ACWT (despite SUADPS customers directly requisitioning through ASO), due to lowered SMA.

FIGURE 11 displays the 75th percentile ACWT values (IPG I & II only) for both SUADPS and non-SUADPS customers, considered with and without the consumer level of inventory. The results from the first perspective show that currently (baseline), 75 percent of all 1R Cog requests are filled within 691 hours for SUADPS customers and within 471 hours for non-SUADPS (i.e., NADEP) customers. With the elimination of retail for collocated items only, these ACWT values would increase to 704 hours (up 2%) and 496 hours (up 5%), respectively. With the total elimination of all retail levels, these ACWT values would escalate to 714 hours (up 3%) and 516 hours (up 10%), respectively.

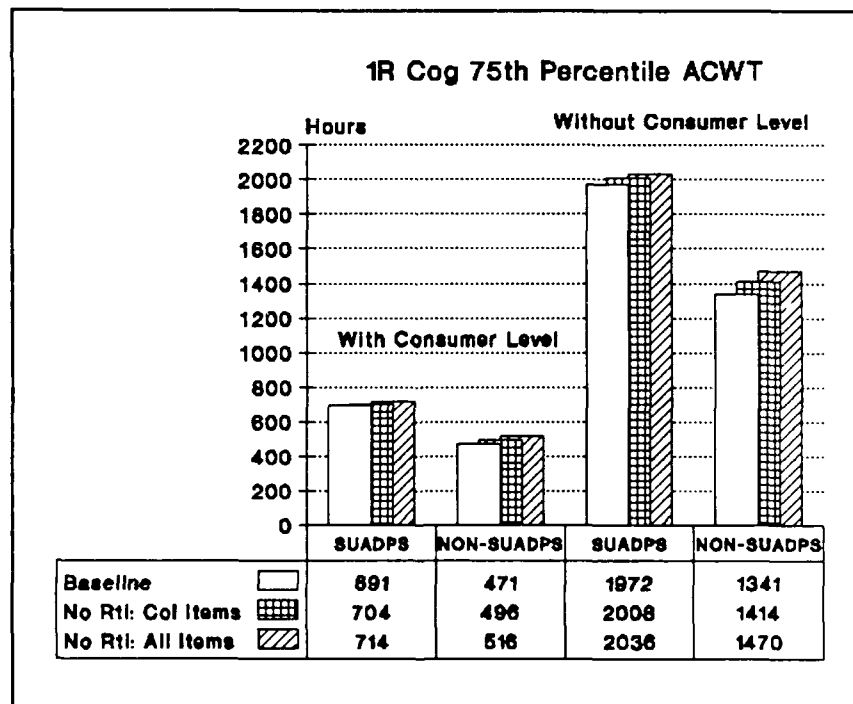


Figure 11 1R Cog 75th Percentile ACWT

Current baseline 75th percentile ACWT values for 1R requisitions not satisfied at the consumer level are 1972 hours for SUADPS customers and 1341 hours for NADEP customers. With the elimination of retail for collocated items, this 75th percentile ACWT will increase to 2008 hours and 1414 hours, respectively. With the total elimination of all retail, it would increase to 2036 hours and 1470 hours, respectively. The relative percent of increase for each statistic is the same as when considering ACWT from the first perspective.

FIGURE 12 shows the same information as FIGURE 11 except that all ACWT values represent the median. The baseline data can be interpreted as follows: half of all 1R material requests from SUADPS customers can be satisfied within 448 hours and half cannot. For NADEP customers, the baseline median ACWT is 298 hours. (Both of these baseline ACWT computations assume 65% material availability within two hours at the consumer echelon. Nevertheless, fewer than half of all 1R Cog requests can be satisfied within the 125 hour ACWT goal.)

TABLE XI provides a summary of the expected percentage increase in ACWT for 1R Cog material after eliminating all or part of 1R retail levels. As with 1H Cog, the percentage increase is approximately the same for ACWT computed from either perspective (with or without the inclusion of the consumer level of inventory). Furthermore, there is little variation in the percentage values for the three statistics: mean, median, and 75th percentile. The key 1R Cog results are evident from TABLE XI: (1) the elimination of only the collocated 1R Cog retail levels would result in a 2% to a 6% increase in ACWT, and (2) the elimination of all 1R Cog retail levels would result in a 3% to 11% increase in ACWT.

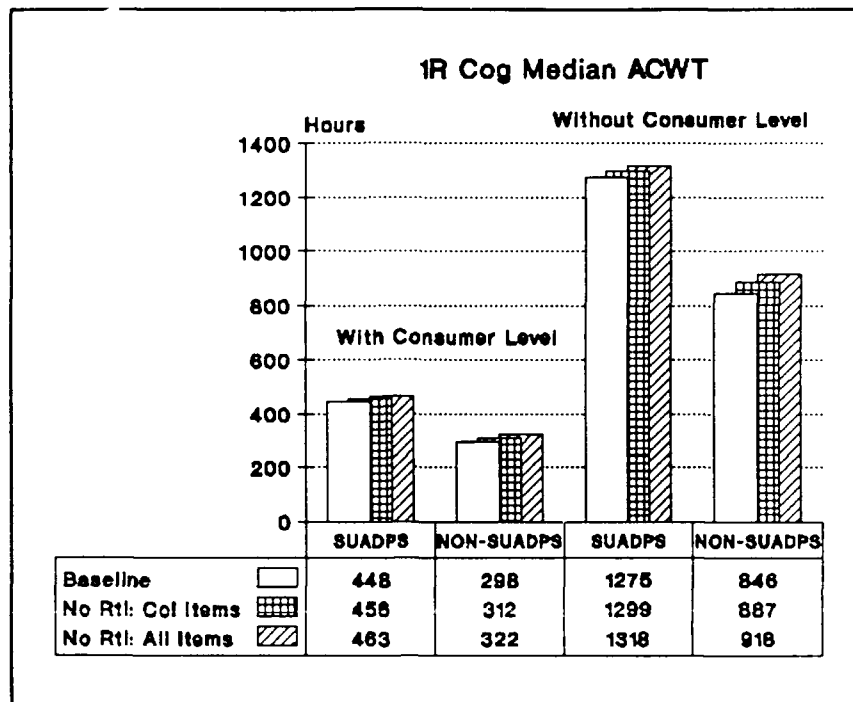


Figure 12 1R Cog Median ACWT

TABLE XI

1R Cog System Summary of Percentage Increase in ACWT  
after Elimination of Collocated/All Retail Levels

	ACWT W/CONSUMER LEVEL		ACWT W/O CONSUMER LEVEL	
	SUADPS	NADEPS	SUADPS	NADEPS
ELIMINATION OF COLL RET				
75TH PERCENTILE	2%	5%	2%	5%
MEDIAN	2%	5%	2%	5%
MEAN	2%	6%	2%	6%
ELIMINATION OF ALL RET				
75TH PERCENTILE	3%	10%	3%	10%
MEDIAN	3%	8%	3%	9%
MEAN	3%	10%	3%	11%

3. Individual NSC Results. APPENDIX D contains the comparative bar charts (Figures 7 through 16) showing the impact on ACWT by individual NSC. As with the "system" charts, each graph contains groups of three bars: (1) the shortest bar represents the baseline (current) ACWT, (2) the middle bar represents expected ACWT after eliminating collocated retail, and (3) the tallest bar represents expected ACWT after eliminating all retail levels. The following results and the charts by individual NSC are all restricted to IPG I and II requisitions for the ACWT calculation. TABLES XII and XIII, which follow, summarize the impact on the median ACWT by individual NSC for 1H and 1R Cogs, respectively. The ranges in both tables provide the "low" and "high" values, which we obtained by individually evaluating each NSC.

TABLE XII

1H Cog Range of Increase in Median ACWT  
(Evaluated for Each NSC)  
after Elimination of Collocated/All Retail Levels

	% INCREASE	HOURS INCREASE IN ACWT INCLUDING CONSUMER LEVEL	HOURS INCREASE IN ACWT EXCLUDING CONSUMER LEVEL
<u>1H COLLOCATED</u>			
SUADPS	10% to 21%	64 (JAX) to 80 (PUG)	184 (JAX) to 231 (PUG)
NON-SUADPS	20% to 33%	29 (JAX) to 91 (CHA)	83 (JAX) to 258 (CHA)
<u>1H ALL</u>			
SUADPS	14% to 30%	83 (CHA) to 124 (PUG)	238 (CHA) to 357 (PUG)
NON-SUADPS	34% to 50%	48 (JAX) to 124 (SAN)	136 (JAX) to 355 (SAN)

The results in TABLE XII show that if only the 1H Cog collocated retail levels are eliminated, the median ACWT across all customers/NSCs will increase from 10% to 33%. In hours, the range of increased time is 29 hours to 91 hours. From the perspective of ACWT for requisitions not satisfied at the consumer level, the range of increased time is 83 hours to 258 hours. The bottom line is that we can expect customers requisitioning 1H Cog items beyond



the consumer level to wait an additional three to eleven days for the material if only the collocated 1R Cog retail levels are eliminated. TABLE XII also shows that if all 1R Cog retail levels are eliminated, the median ACWT across all customers/NSCs will increase 14% to 50%. In hours, the range of increased time is 48 hours to 124 hours. From the perspective of ACWT for requisitions not satisfied at the consumer level, the range of increased time is 136 hours to 357 hours. The bottom line is that we can expect customers requisitioning 1R Cog items beyond the consumer level to wait an additional six to fifteen days for the material if all 1R Cog retail levels are eliminated.

TABLE XIII

1R Cog Range of Increase in Median ACWT  
(Evaluated for Each NSC)  
after Elimination of Collocated/All Retail Levels

	% INCREASE	HOURS INCREASE IN ACWT INCLUDING CONSUMER LEVEL	HOURS INCREASE IN ACWT EXCLUDING CONSUMER LEVEL
<u>1R COLLOCATED</u>			
SUADPS	1% to 3%	6 (PEN) to 20 (JAX)	18 (PEN) to 57 (JAX)
NADEPS	4% to 7%	10 (JAX,SAN) to 22 (NOR)	29 (SAN) to 63 (NOR)
<u>1R ALL</u>			
SUADPS	2% to 5%	12 (PEN,SAN) to 32 (JAX)	34 (PEN) to 91 (JAX)
NADEPS	7% to 11%	17 (JAX) to 34 (NOR,OAK)	49 (JAX) to 96 (NOR)

Due to the 1R Cog "lock-out" which excludes non-NADEP customers from requisitioning through an intermediate level activity, our results focus on the NADEPs. For this customer universe, the results in TABLE XIII show that if only the 1R Cog collocated retail levels are eliminated, the median ACWT will increase from 4% to 7%. In hours, the range of increased time is 10 hours to 22 hours. From the perspective of ACWT for requisitions not satisfied at the consumer level, the range of increased time is 29 hours to 63 hours. The bottom line is that we can expect customers requisitioning 1R Cog

items beyond the consumer level to wait an additional one to three days for the material if only the collocated 1R Cog retail levels are eliminated.

TABLE XIII also shows that if all 1R Cog retail levels are eliminated, the median ACWT across all customers/NSCs will increase 7% to 11%. In hours, the range of increased time is 17 hours to 34 hours. From the perspective of ACWT for requisitions not satisfied at the consumer level, the range of increased time is 49 hours to 96 hours. The bottom line is that we can expect customers requisitioning 1R Cog items beyond the consumer level to wait an additional two to four days for the material if all 1R Cog retail levels are eliminated.

4. Summary of Impact on ACWT. TABLEs XIV and XV summarize the expected increases in median ACWT for 1H and 1R Cogs, respectively, resulting from the elimination of collocated or all retail levels. These summaries are based upon median response times computed from IPG I & II requisition data, for all NSCs combined. Notice that the current or baseline ACWT values in both tables are already more than two to three times the goals of 125/352 hours.

TABLE XIV

1H Cog Overall Increase in Median ACWT  
after Elimination of Collocated/All Retail Levels

	% INCREASE	BASELINE ACWT + HOURS INCREASE IN ACWT INCLUDING CONSUMER LEVEL (GOAL - 125 HRS.)	BASELINE ACWT + HOURS INCREASE IN ACWT EXCLUDING CONSUMER LEVEL (GOAL - 352 HRS.)
<u>1H COLLOCATED</u>			
SUADPS	20%	Baseline 363 + 72 hrs.	Baseline 1033 + 205 hrs.
NON-SUADPS	30%	Baseline 256 + 78 hrs.	Baseline 728 + 223 hrs.
<u>1H ALL</u>			
SUADPS	28%	Baseline 363 + 100 hrs.	Baseline 1033 + 287 hrs.
NON-SUADPS	43%	Baseline 256 + 109 hrs.	Baseline 728 + 312 hrs.

TABLE XV

1R Cog Overall Increase in Median ACWT  
after Elimination of Collocated/All Retail Levels

	% INCREASE	BASELINE ACWT + HOURS INCREASE IN ACWT INCLUDING CONSUMER LEVEL (GOAL = 125 HRS.)	BASELINE ACWT + HOURS INCREASE IN ACWT EXCLUDING CONSUMER LEVEL (GOAL = 352 HRS.)
<u>1R COLLOCATED</u>			
SUADPS	2%	Baseline 448 + 8 hrs.	Baseline 1275 + 24 hrs.
NADEPS	5%	Baseline 298 + 14 hrs.	Baseline 846 + 41 hrs.
<u>1R ALL</u>			
SUADPS	3%	Baseline 448 + 15 hrs.	Baseline 1275 + 43 hrs.
NADEPS	8%	Baseline 298 + 24 hrs.	Baseline 846 + 72 hrs.

F. COST TO MAINTAIN CURRENT ACWT. The basic premise of this analysis is that the practical implementation of GAO's recommendation would necessitate that all retail levels at intermediate activities be eliminated. In the ensuing analysis, we raised the following questions: "How much improvement is required in the gross availability at the wholesale level to compensate for the lowered effectiveness at the intermediate level? What is the cost associated with this requirement?" That is, we determined how to maintain ACWT at its current performance if retail levels disappeared. (Note that current ACWT is at best twice the 125 hour goal, and that this analysis does not address how to improve it, rather how to maintain it.)

First, we used the definition of ACWT to solve for SMA, given that ACWT and all other variables are known. The solution is:

SMA =

$$[\text{WRT(NA)} - \text{Baseline ACWT} - \text{P(I)} * (\text{WRT(A)} - \text{IRT(A)})] / [\text{WRT(NA)} - \text{WRT(A)}]$$

where:

WRT(NA) - TRRT for Backorders

WRT(A) - TRRT for Referral Immediate Issues

IRT(A) - TRRT for Point of Entry Immediate Issues

P(I) - Probability the Material is Available at the Intermediate Level

To compute SMA, we used P(I) equal to the FY81 POE values, our only available estimate of gross availability at the intermediate level activity after the removal of retail levels. Then, we used the definition of RE to compute RE, equal to  $(SMA - POE)/(1 - POE)$ .

For 1H Cog, we computed six different estimates of required RE (by NSC), corresponding to each ACWT statistic (mean, median, and 75th percentile) and to each customer universe (SUADPS and non-SUADPS). From these estimates, we selected the RE values based upon median ACWT and display them in TABLE XVI. (Note that, in general, the RE based upon the median provides a "best central estimate".)

TABLE XVI

1H Cog (Wholesale) Referral Effectiveness  
Required to Maintain Current Median ACWT  
after the Elimination of All Retail Levels

	BASELINE REF EFFECTIVENESS	REQUIRED REF EFFEC		INCREASE IN REF EFFEC	
		NON-SUADPS	SUADPS	NON-SUADPS	SUADPS
NSC CHARLESTON	37.7%	58.7%	62.4%	21.0 % pts	24.7 % pts
NSC JACKSONVILLE	73.2%	76.3%	78.8%	3.1 % pts	5.5 % pts
NSC NORFOLK	56.7%	73.5%	74.9%	16.8 % pts	18.2 % pts
NSC OAKLAND	69.6%	79.0%	81.2%	9.4 % pts	11.6 % pts
NSC PUGET SOUND	59.7%	82.5%	87.7%	22.8 % pts	28.0 % pts
NSC SAN DIEGO	68.8%	78.0%	78.1%	9.3 % pts	9.3 % pts
NSC TOTAL	60.3%	74.9%	76.4%	14.6 % pts	16.1 % pts

For 1R Cog, we computed the same statistics, but for only the NADEP customer universe (since all others requisition through ASO due to the 1R Cog "lock-out"). TABLE XVII displays the RE based upon the median baseline ACWT, the best central estimate of the required RE to maintain current overall response times.

TABLE XVII

1R Cog (Wholesale) Referral Effectiveness  
Required to Maintain Current Median ACWT  
after the Elimination of All Retail Levels

	BASELINE REF EFFECTIVENESS	REQUIRED REF EFFECTIVENESS	INCREASE IN REFERRAL EFFECTIVENESS
NSC JACKSONVILLE	53.7%	62.4%	8.7 % points
NSC NORFOLK	41.0%	63.2%	22.2 % points
NSC OAKLAND	55.2%	69.7%	14.5 % points
NSC PENSACOLA	47.9%	66.9%	19.0 % points
NSC SAN DIEGO	51.1%	63.3%	12.2 % points
NSC TOTAL	49.9%	64.6%	14.8 % points

We used the FMSO Budget and Readiness Model (BAR), reference (9) of APPENDIX A, to predict the estimated cost to "beef up" the wholesale levels in compensation for reduced intermediate levels of stock, while maintaining baseline ACWT. The BAR model is a linear regression model which is structured to predict availability as a linear function of the natural logarithm of the investment. Through a transformation of variables, we computed the predicted wholesale budget as an exponential function of three variables: the current wholesale budget, the current RE, and the RE required to maintain ACWT. We used the following formula:

$$D2 = \exp [ (RE2 - RE1 + (A * \ln(D1))) / A ]$$

where:

D2 = Required wholesale investment to achieve required RE

D1 = Baseline wholesale investment

RE2 = Referral Effectiveness required to maintain ACWT after drop in POE

RE1 = Referral Effectiveness Baseline (prior to drop in POE)

A = slope of regression line which relates availability to the budget

(A=85.3320 for 1H Cog wholesale; A=61.9627 for 1R Cog wholesale)

ln = natural logarithm function

exp = exponential function

For RE1, we used the FY81 effectiveness statistics which are given in TABLE II of APPENDIX D. The RE2 values which we used in the computation of D2 are given in TABLES XVI and XVII for 1H and 1R Cogs, respectively. For the baseline wholesale investment, we used January 1989 MSPR data and June 1989 MCL data. We applied the following formula to compute D1:

$$\begin{aligned} D1 = & (\$ \text{ WHOLESALE ASSETS FOR DEMAND-BASED ITEMS per JAN 1989 MSPR}) \\ & + (\$ \text{ JUNE 1989 MCL TOTAL ASSETS FOR NON-VOSL ITEMS}) \\ & - (\$ \text{ JUNE 1989 MCL RESERVATION QUANTITIES}) \\ & - (\$ \text{ JUNE 1989 MCL ADDITIVE PORTION OF NSOs}) \end{aligned}$$

In addition to the above formula for D1, we also used two other estimates for D1 in predicting D2. A noteworthy result of using multiple D1 values is that we found that the percentage increase,  $(D2 - D1)/D1$ , is insensitive to the D1 value used. Therefore, the percentage increase in the current wholesale investment, as shown in the right-most portion of TABLES XVIII and XIX which follow, is constant, regardless of the value used for the current wholesale budget.

TABLES XVIII and XIX contain the 1H and 1R Cog, respectively, estimated investment required at the wholesale level, by individual NSC, in order to achieve the RE values supplied in TABLES XVI and XVII.

TABLE XVIII

Required 1H Cog Wholesale Budget  
to Achieve Required RE/Maintain ACWT

	BASELINE WHOLESALE (D1)	ADDITIONAL REQ'D WHOLESALE (D2-D1)		PERCENTAGE INCREASE IN WHOLESALE INVEST	
		NON-SUADPS	SUADPS	NON-SUADPS	SUADPS
NSC CHARLESTON	\$112.4M	\$31.3M	\$37.7M	27.9%	33.6%
NSC JACKSONVILLE	\$ 22.4M	\$ 0.8M	\$ 1.5M	3.7%	6.7%
NSC NORFOLK	\$200.1M	\$43.7M	\$47.5M	21.8%	23.7%
NSC OAKLAND	\$ 27.8M	\$ 3.2M	\$ 4.1M	11.7%	14.6%
NSC PUGET SOUND	\$ 40.0M	\$12.2M	\$15.5M	30.6%	38.8%
NSC SAN DIEGO	\$166.1M	\$19.1M	\$19.2M	11.5%	11.5%
NSC TOTAL	\$568.9M	\$106.1M	\$117.9M	18.6%	20.7%
NOTE: The NSC totals (\$106.1M and \$117.9M) which appear at the bottom of TABLE XVIII were computed using the formula for D2, and are not expected to equal the sum of the individual NSC values for D2. Also note that maintenance of ACWT will require an estimated additional \$106.1M minimum investment in wholesale stock, based upon non-SUADPs customers' response times. However, based upon SUADPS customers, this cost estimate is a maximum of \$117.9M. (Our analysis uses the lesser of the two cost estimates.)					

TABLE XIX

Required 1R Cog Wholesale Budget  
to Achieve Required RE/Maintain ACWT

	BASELINE WHOLESALE (D1)	ADDITIONAL REQ'D WHOLESALE (D2-D1) (for NADEPs)	PERCENTAGE INCREASE IN WHOLESALE INVEST (for NADEPs)
NSC JACKSONVILLE	\$213.2M	\$32.2M	15.1%
NSC NORFOLK	\$198.4M	\$85.6M	43.1%
NSC OAKLAND	\$215.6M	\$57.0M	26.4%
NSC PENSACOLA	\$178.2M	\$64.0M	35.9%
NSC SAN DIEGO	\$152.7M	\$33.4M	21.9%
NSC TOTAL	\$958.1M	\$258.1M	26.9%

NOTE: The NSC total (\$258.1M) which appears at the bottom of TABLE XIX was computed using the formula for D2, and is not expected to equal the sum of the individual NSC values of D2. Therefore, to maintain ACWT for NADEPs will require an estimated additional \$258.1M investment in wholesale stock. This expenditure will result in improved ACWT for all other (i.e., non-NADEP) customers, which comprise roughly 80% of our 1R Cog material receipt volume.

TABLES XVIII and XIX reveal the additional costs (\$106.1M for 1H and \$258.1M for 1R Cog) to the wholesale inventory necessary to maintain the current ACWT given the elimination of all retail levels. We now prorate this estimate to consider the lesser cost of increasing the wholesale budget to offset the degradation in ACWT due to the loss of retail for collocated items. To prorate costs, we applied the ratio of AFIL for the group of collocated items to the AFIL for the total universe of all items. This calculation yields a wholesale requirement of \$43.8M for 1H Cog and \$87.1M for 1R Cog.

G. COST-BENEFIT COMPARISON. This section summarizes the costs and savings associated with either the elimination of all retail levels or the elimination of only collocated retail levels. In section II.D, we identified the one-time savings achieved via elimination of collocated/all retail levels. We also identified the one-time cost to increase retail levels for noncollocated items to 2.5 months AIL in the event of the elimination of collocated retail levels.



Furthermore, we computed the one-time cost to fully fund the nonsupported portion of the NSOs after the elimination of collocated retail levels. In section II.E, we evaluated the "cost" in terms of increased hours ACWT resulting from elimination of collocated/all retail levels. Finally, in Section II.F, we presented the costs to increase the wholesale budget to compensate for either the elimination of all or only collocated retail material at the intermediate level activities and thereby maintain the current ACWT. TABLES XX and XXI provide a concise summary of inventory increases and decreases which we have considered in this study. (Our conclusions in the Abstract, Executive Summary, and Section III are based upon data which we have summarized in these two tables.)

TABLE XX shows that eliminating collocated 1H Cog retail levels results in a one-time savings of \$5.6M which is more than offset by a one-time cost of \$43.8M. For every \$1 saved in collocated 1H retail levels, we need to spend \$8 in wholesale levels to maintain the same system performance. If all retail levels are removed, a one-time savings of \$25.1M results; however, this is more than offset by a one-time cost of \$106.1M. For every \$1 saved in by eliminating all 1H retail levels, we need to spend \$4 in wholesale levels to maintain the same system responsiveness.

TABLE XX

Cost-Benefit Summary of Analysis  
Elimination of Collocated/All Retail Levels  
for 1R Cog

	ELIMINATION OF ALL RETAIL	ELIMINATION OF COLLOCATED RETAIL
AFIL Savings	Save \$ 26.4M	Save \$ 10.9M
Increase Noncolloc. Items' AIL	---	Cost \$ 4.6M
Fund Nonsupported NSOs	Cost \$ 1.3M	Cost \$ .7M
NET ONE-TIME SAVINGS	Save \$ 25.1M	Save \$ 5.6M
Effect on ACWT	Up 28%	Up 20%
Additional Hours ACWT	100 hrs.	72 hrs.
Added Whls. Lvl's to Maintain ACWT	Cost \$106.1M	Cost \$ 43.8M
NET TO MAINTAIN ACWT	Cost \$ 81.0M	Cost \$ 38.2M

TABLE XXI shows that eliminating collocated 1R Cog retail levels results in a one-time savings of \$5.8M which is more than offset by a one-time cost of \$87.1M. For every \$1 saved in collocated 1R retail levels, we need to spend \$15 in wholesale levels to maintain the same system performance. If all retail levels are removed, a one-time savings of \$55.5M accrues; however, this is more than offset by a one-time cost of \$258.1M. For every \$1 saved by eliminating all 1R retail levels, we need to spend \$5 in wholesale levels to maintain the same system responsiveness.

TABLE XXI  
Cost-Benefit Summary of Analysis  
Elimination of Collocated/All Retail Levels  
for 1R Cog

	ELIMINATION OF ALL RETAIL	ELIMINATION OF COLLOCATED RETAIL
AFIL Savings	Save \$ 55.7M	Save \$ 18.8M
Increase Noncolloc. Items' AIL	---	Cost \$ 12.9M
Fund Nonsupported NSOs	Cost \$ .2M	Cost \$ .1M
NET ONE-TIME SAVINGS	Save \$ 55.5M	Save \$ 5.8M
Effect on NADEP ACWT	Up 8%	Up 5%
Additional Hours NADEP ACWT	24 hrs.	14 hrs.
Added Whls. Lvl's to Maintain ACWT	Cost \$258.1M	Cost \$ 87.1M
NET TO MAINTAIN ACWT	Cost \$202.2M	Cost \$ 81.3M

In addition to the one-time increases and decreases in inventory levels, there are also annual cost/savings factors present. These factors, holding cost rate and maintenance cost rate, are expressed as percentages which are then applied equally to the one-time costs/savings to calculate the recurring (i.e., annual) costs/savings. We did not quantify annual costs/savings in this study, since the annual rates apply to both the increases and decreases in inventory levels; consequently, the ratio of annual costs to annual savings will be in the same proportion as the ratio of one-time costs to one-time savings.

For example, 1H Cog consumable items have a holding cost rate of 23% and a maintenance cost rate of 8.6%. The current cost to benefit ratio for initial inventory reductions for these items is equal to:

$$\frac{\text{Cost}}{\text{Benefit}} = \frac{\text{Inventory Increase at Wholesale Level}}{\text{Inventory Reduction at Intermediate Level}} = \frac{106.1\text{M}}{26.4\text{M}} = 4.0$$

Thus, it costs four times as much in inventory at the wholesale level as compared to the reduction in inventory at the intermediate level from totally removing intermediate levels. The annual cost to benefit ratio is equal to:

$$\frac{\text{Annual Cost}}{\text{Annual Benefit}} = \frac{\text{Holding and Maintenance Due to Wholesale Inventory Increase}}{\text{Holding and Maintenance Due to Intermediate Inventory Reduction}}$$

$$= \frac{\text{Wholesale Inventory Increase} * (\text{Holding Cost Rate} + \text{Maintenance Cost Rate})}{\text{Intermediate Inventory Reduction} * (\text{Holding Cost Rate} + \text{Maintenance Cost Rate})}$$

$$= \frac{106.1\text{M} * .23 * .086}{26.4\text{M} * .23 * .086} = \frac{2.0\text{M}}{0.5\text{M}} = 4.0$$

Again, it annually costs four times as much as one saves by eliminating intermediate levels.

### III. SUMMARY AND CONCLUSIONS

The major areas examined in this study were the extent of collocation of intermediate and wholesale inventories from 1 January 1985 to 1 January 1989, the impact on inventory levels and ACWT which would result from the removal of the collocated intermediate inventory levels and all intermediate inventory levels, and the cost to maintain the current ACWT given the removal of intermediate levels.

The number of 1H Cog retail items decreased 3% (1.7K) over the five year period while the total number of collocated items increased by 12% (4.8K). In the same period, the wholesale assets for collocated items increased 9% (\$30.1M); however, they dropped \$77.1M between January 1988 and January 1989. Overall the 1R Cog retail items declined 27% (8.6K) with a decrease in collocated items of 41% (5.0K). The wholesale assets for collocated 1R Cog items increased 20% (\$93.3M) in the five years.

For 1H Cog, 95% of the total wholesale assets for collocated items are for demand-based items. Additionally, only 8% of the total assets are retail

requirements. For 1R Cog, 99% of the wholesale assets for collocated items are for demand-based items and only 10% of the total assets are for retail requirements.

The elimination of only collocated retail item levels for 1H Cog would reduce retail inventory by \$10.9M with at least a 72 hour increase in ACWT for these items. Projecting the wholesale inventory cost to maintain ACWT produced a cost of \$43.8M. Other additional costs are the cost to increase AFIL for noncollocated retail items to 2.5 month AFIL and the cost to fund non-supported NSOs. These costs total \$5.3M for 1H Cog. For 1R Cog, the retail savings equals \$18.8M with a NADEP ACWT impact of 14 hours for these items. The wholesale inventory cost to maintain ACWT is \$87.1M, and the cost to fund AFIL and NSOs is \$13.0M. Thus, to maintain the current ACWT, eliminating collocated retail levels would cost at least eight times as much as it would save.

In practice, because UADPS cannot readily distinguish between retail and wholesale assets, it would be difficult (if not impossible) to remove intermediate levels on only collocated items. Thus, implementing GAO's recommendation could force us to remove all intermediate levels. The total elimination of all retail levels for 1H Cog would reduce retail inventory by \$26.4M but would increase ACWT at least 100 hours. The cost to fully fund the NSOs previously included in the retail levels is \$1.3M. The additional wholesale inventory cost to maintain ACWT at its present level equals \$106.1M. For 1R Cog, the retail inventory reduction equals \$55.7M with a corresponding increase in NADEP ACWT of 24 hours. The wholesale inventory cost to maintain ACWT is \$258.1M and the cost to fully fund the NSOs is \$0.2M. Thus, to

maintain the current ACWT, it would cost us at least four times as much in wholesale inventories as we would save from the elimination of intermediate levels.

In conclusion, the RIMSTOP initiative has resulted in some degree of duplication of inventory; however, the establishment of intermediate levels for 1H and 1R Cogs has more than paid for itself in terms of customer support. The ACWT benefit derived from the intermediate levels was achieved at a fraction (one-fourth for 1H Cog, and one-fifth for 1R Cog) of the wholesale cost increase necessary to achieve the same ACWT.

#### IV. RECOMMENDATIONS

We recommend that existing intermediate levels which are collocated with wholesale levels be maintained for both 1H and 1R Cogs.

#### APPENDIX A: REFERENCES

1. General Accounting Office(GAO) Audit Report NSIAD-87-19
2. ALRAND Working Memorandum 529, Inventory Layering of 30 Dec 1986.
3. Presentation, "The Benefits of 1H Cog Retail Levels", for the 1988 Stock Point Retail Inventory Management Workshop given on 12 May 1988.
4. FMSO ltr 5250 93239/PCK-F62/54 of 31 Mar 1989; Effectiveness of Intermediate Levels Collocated with Wholesale Levels
5. Requisition Response Time Management Information System (RRTMIS II) Reports
6. NAVSUP Publication 295 (FY compilation of monthly Form 1144 data)
7. OPNAVINST 4441.12B; Retail Supply Support of Naval Activities and Operating Forces
8. NAVSUP ltr 04132/JCG/0421A/HEK of 29 OCT 1979; Requirements for Ship Operation Support Inventory (OSI) Implementation
9. Budget and Readiness (BAR) Model (FMSO Document No. N9324-B16-5070)

## APPENDIX B: EXTENT OF COLLOCATION

The graphs displayed in FIGURES 1 through 32 show for each activity (1) the total number of all retail items carried and (2) the dollar value of protected wholesale assets, retail assets, and collocated wholesale assets for collocated items across the 5 years studied. The graphs are segregated by activity (NSC) within Cog breakdown. The following is the order in which the figures appear in this appendix:

<u>Figure</u>	<u>Page</u>
Figure 1 - NSC Charleston-1H Cog, Number of Retail Items	B-3
Figure 2 - NSC Charleston-1H Cog, Total Assets for Collocated Retail Items	B-3
Figure 3 - NSC Jacksonville-1H Cog, Number of Retail Items	B-4
Figure 4 - NSC Jacksonville-1H Cog, Total Assets for Collocated Retail Items	B-4
Figure 5 - NSC Norfolk-1H Cog, Number of Retail Items	B-5
Figure 6 - NSC Norfolk-1H Cog, Total Assets for Collocated Retail Items	B-5
Figure 7 - NSC Oakland-1H Cog, Number of Retail Items	B-6
Figure 8 - NSC Oakland-1H Cog, Total Assets for Collocated Retail Items	B-6
Figure 9 - NSC Puget Sound-1H Cog, Number of Retail Items	B-7
Figure 10 - NSC Puget Sound-1H Cog, Total Assets for Collocated Retail Items	B-7
Figure 11 - NSC San Diego-1H Cog, Number of Retail Items	B-8
Figure 12 - NSC San Diego-1H Cog, Total Assets for Collocated Retail Items	B-8
Figure 13 - NSC Jacksonville-1R Cog, Number of Retail Items	B-9



Figure 14 - NSC Jacksonville-1R Cog, Total Assets for Collocated	
Retail Items	B-9
Figure 15 - NSC Norfolk-1R Cog, Number of Retail Items	B-10
Figure 16 - NSC Norfolk-1R Cog, Total Assets for Collocated	
Retail Items	B-10
Figure 17 - NSC Oakland-1R Cog, Number of Retail Items	B-11
Figure 18 - NSC Oakland-1R Cog, Total Assets for Collocated	
Retail Items	B-11
Figure 19 - NSC Pensacola-1R Cog, Number of Retail Items	B-12
Figure 20 - NSC Pensacola-1R Cog, Total Assets for Collocated	
Retail Items	B-12
Figure 21 - NSC San Diego-1R Cog, Number of Retail Items	B-13
Figure 22 - NSC San Diego-1R Cog, Total Assets for Collocated	
Retail Items	B-13

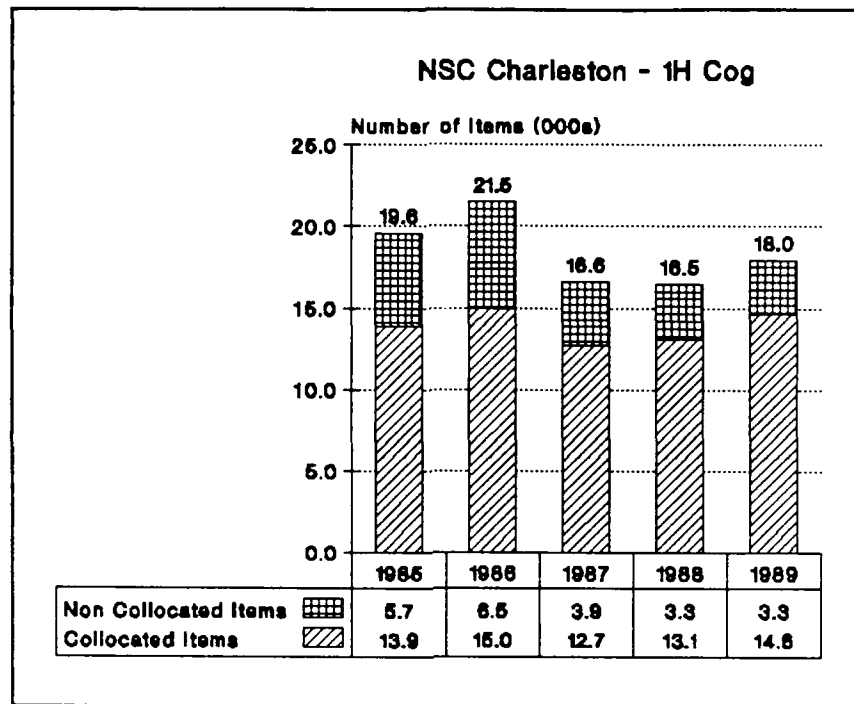


Figure 1

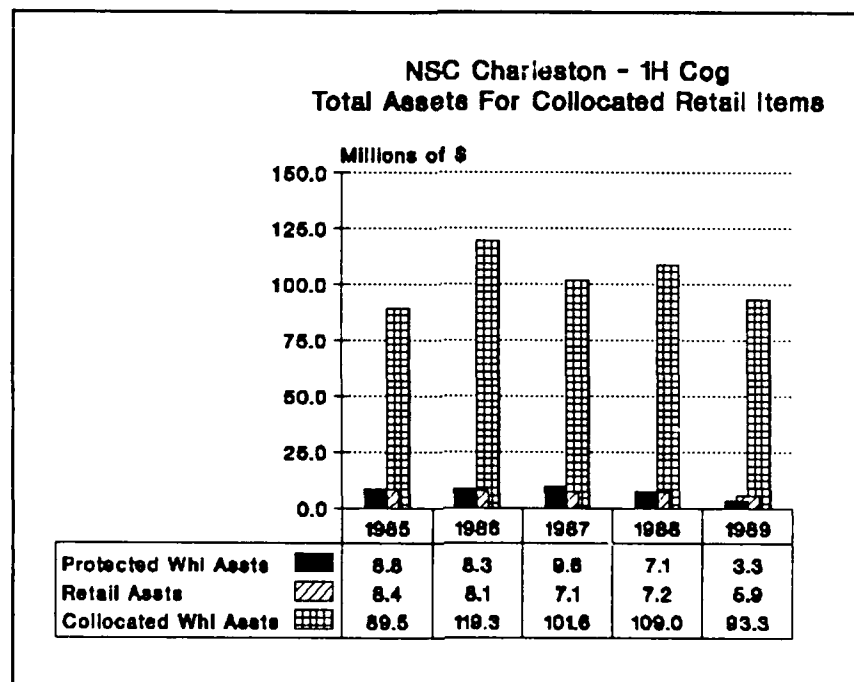


Figure 2

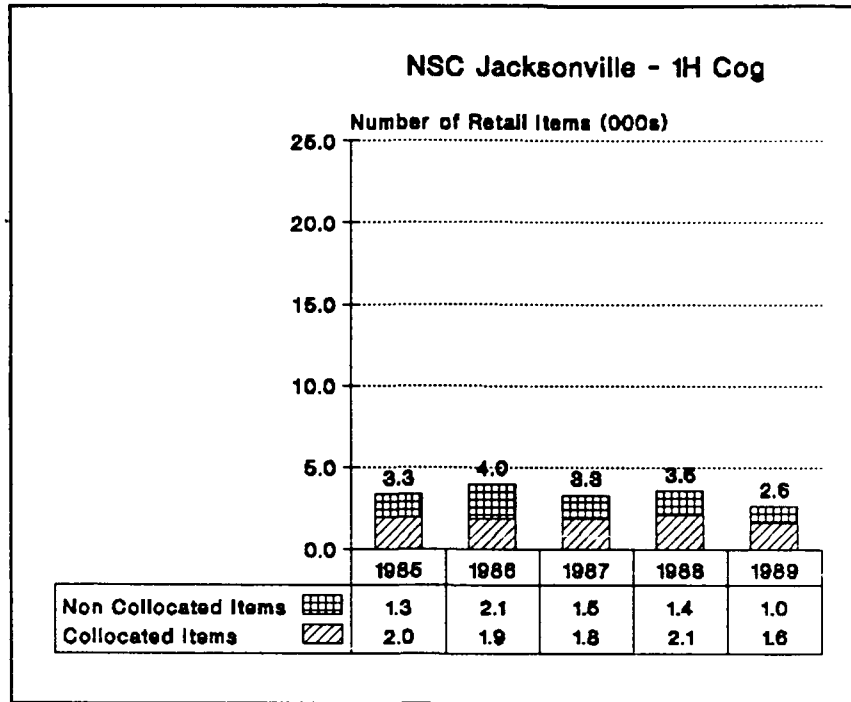


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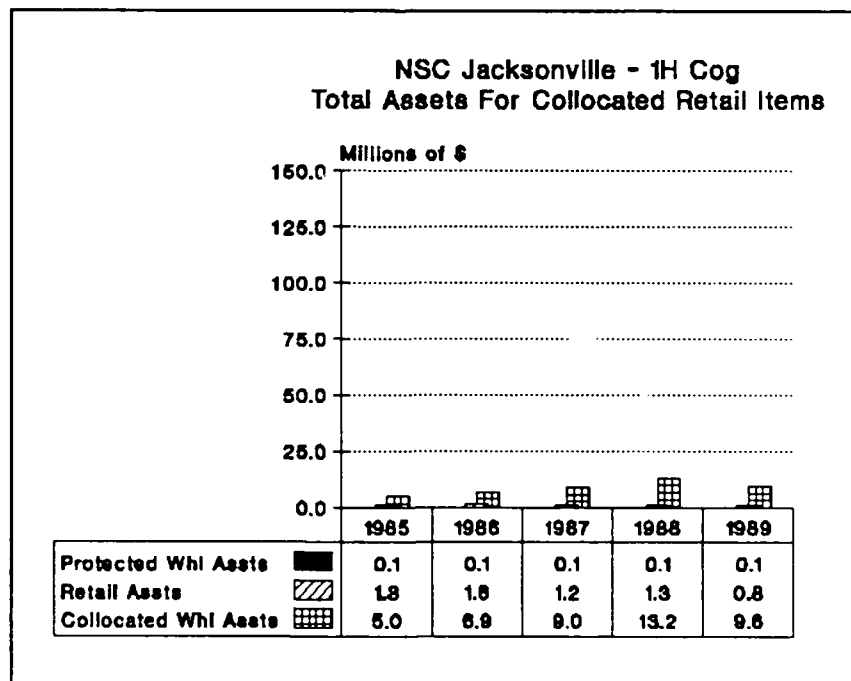


Figure 4

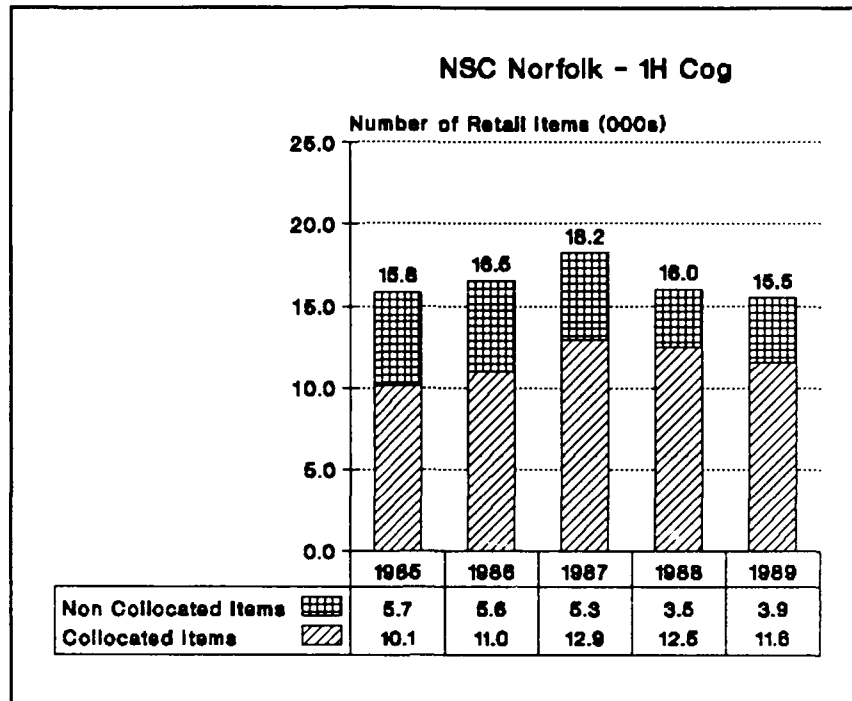


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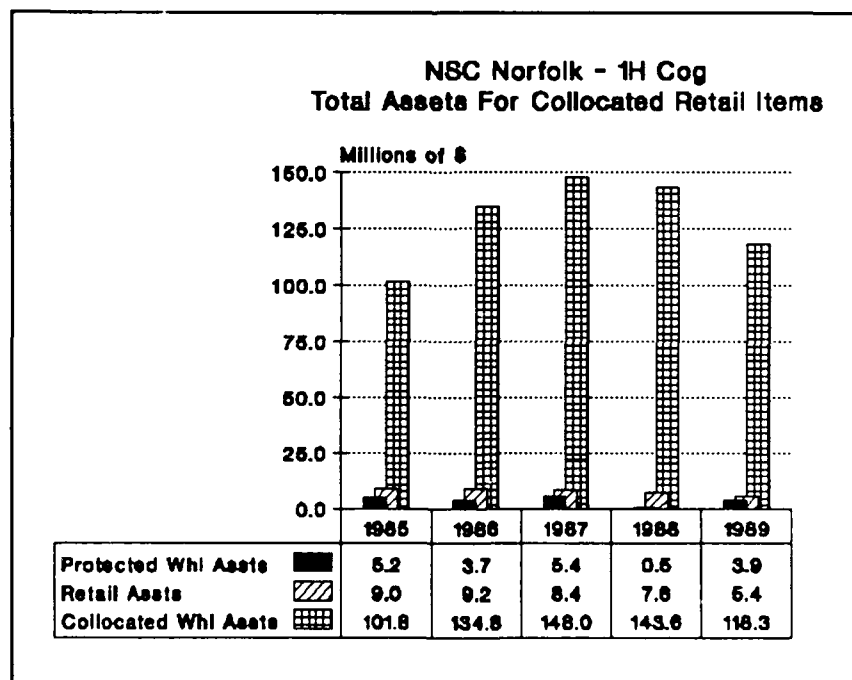


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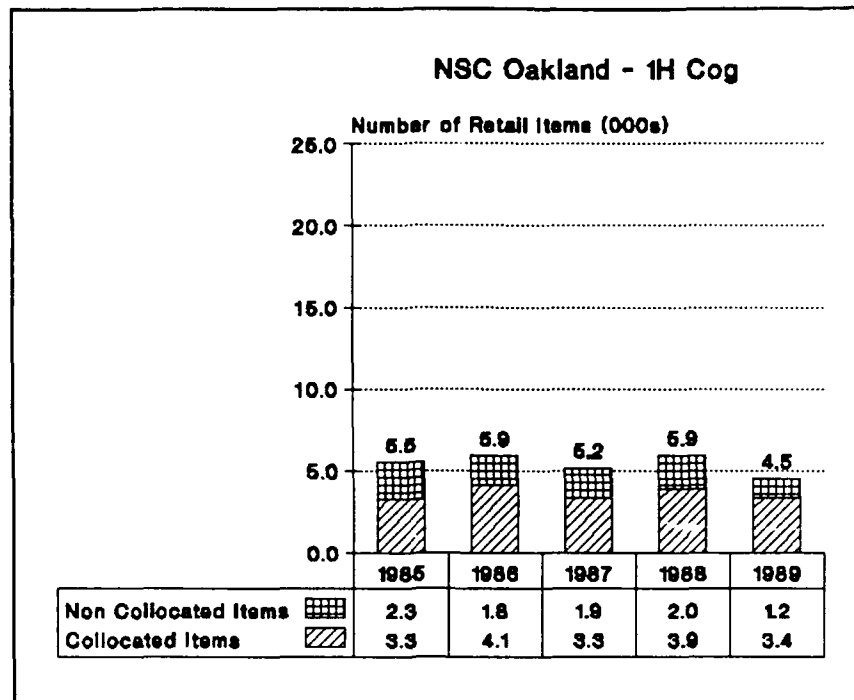


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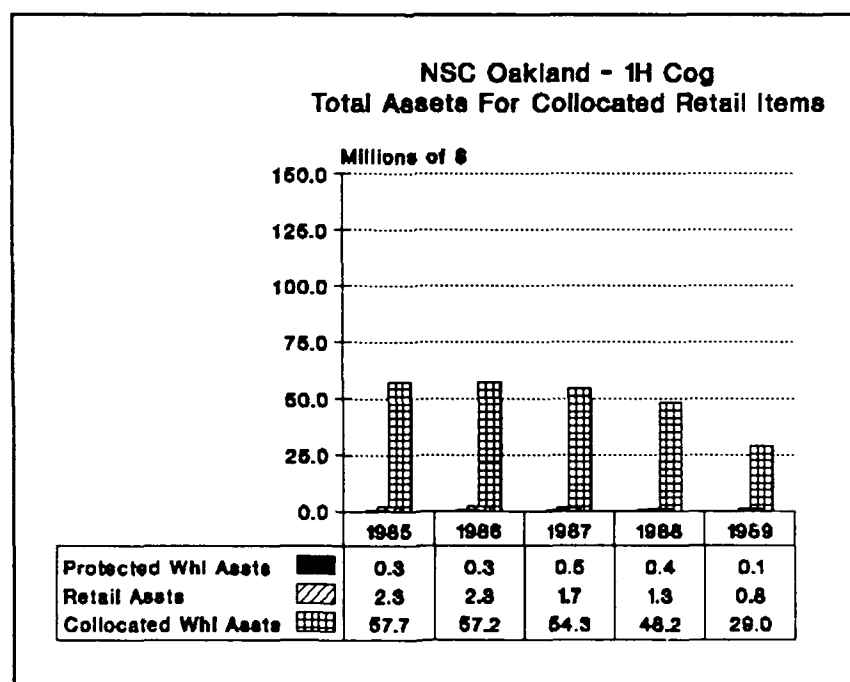


Figure 8

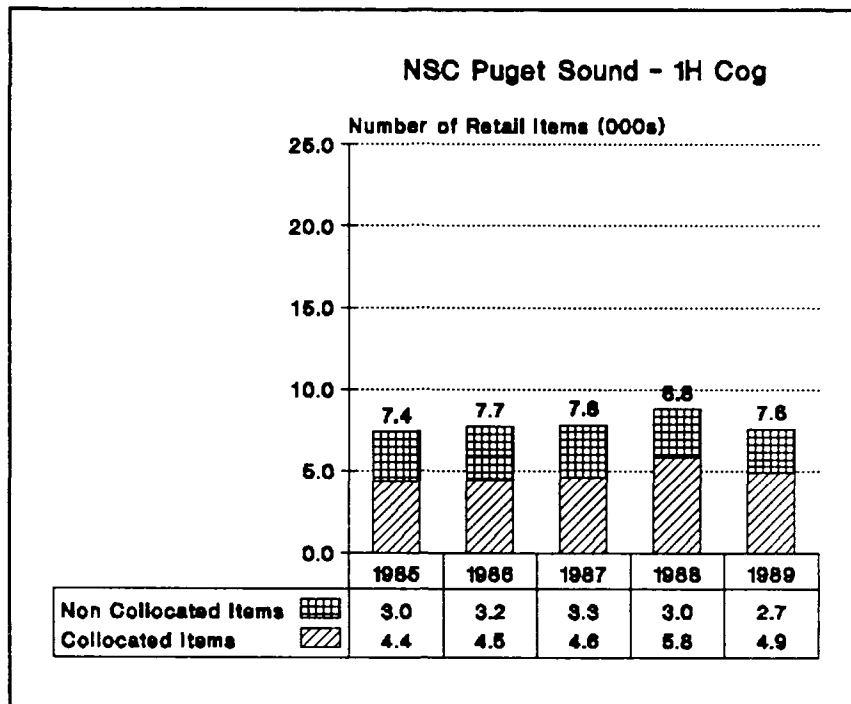


Figure 9

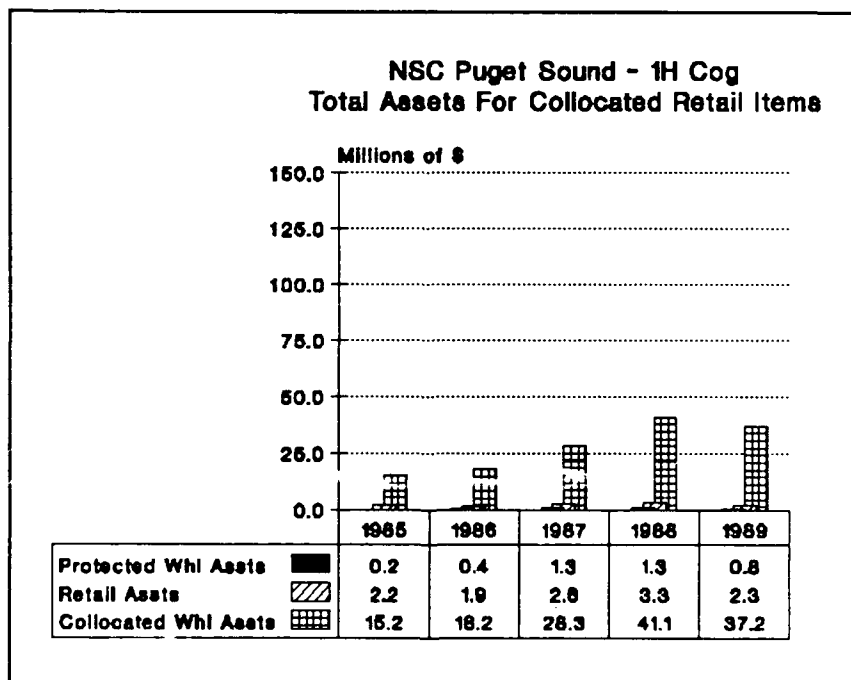


Figure 10

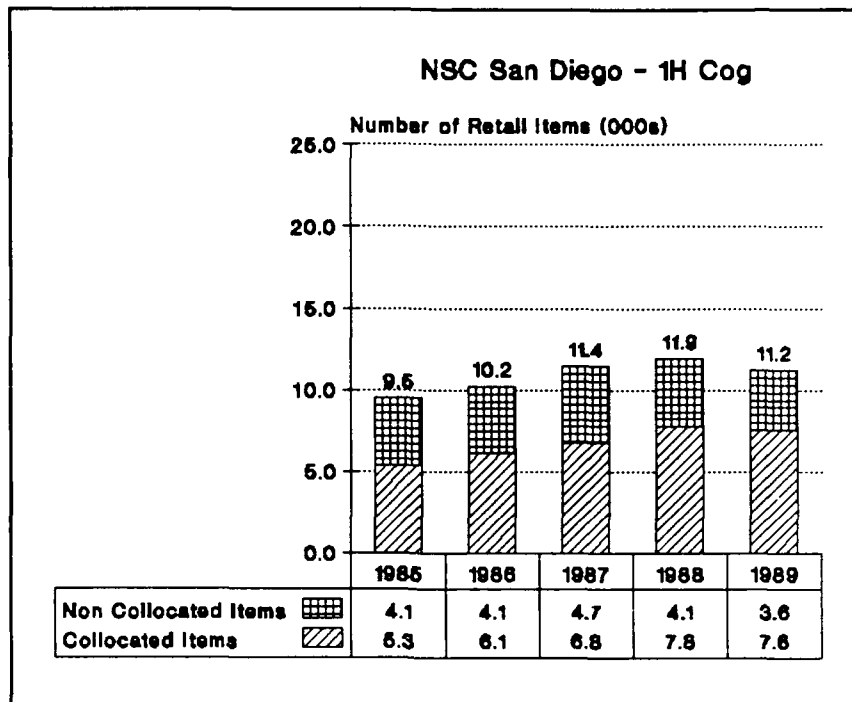


Figure 11

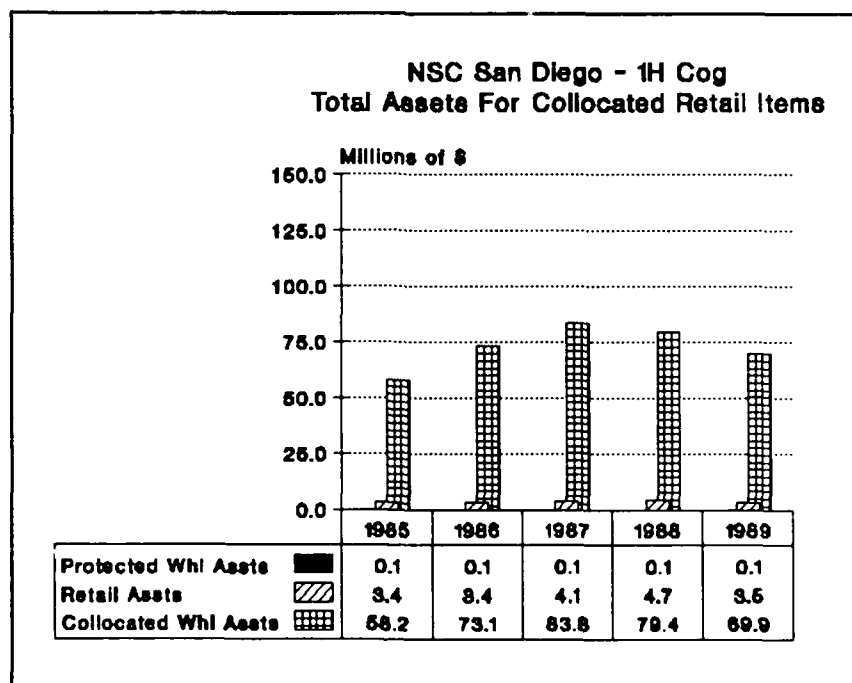


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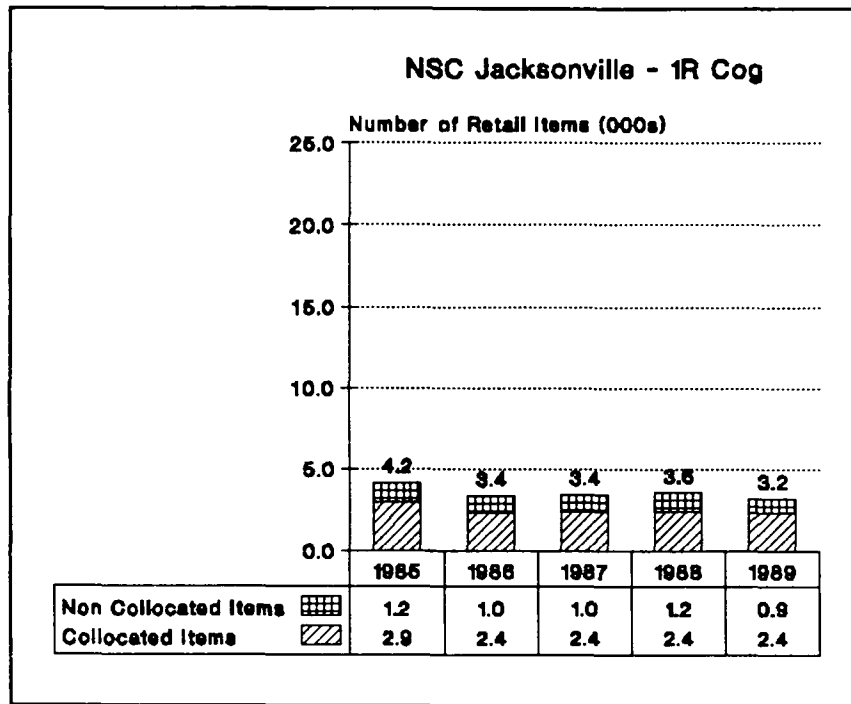


Figure 13

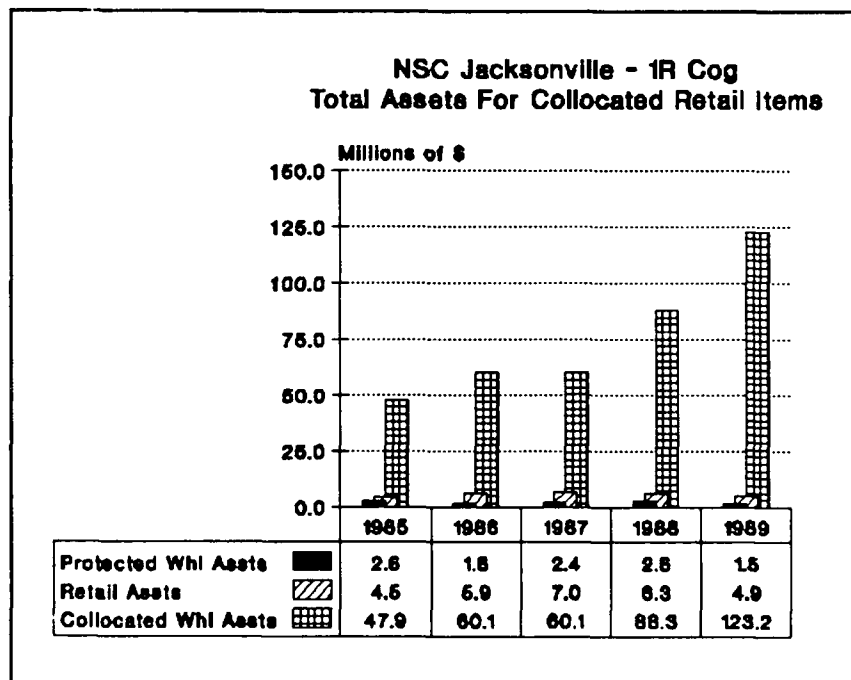


Figure 14



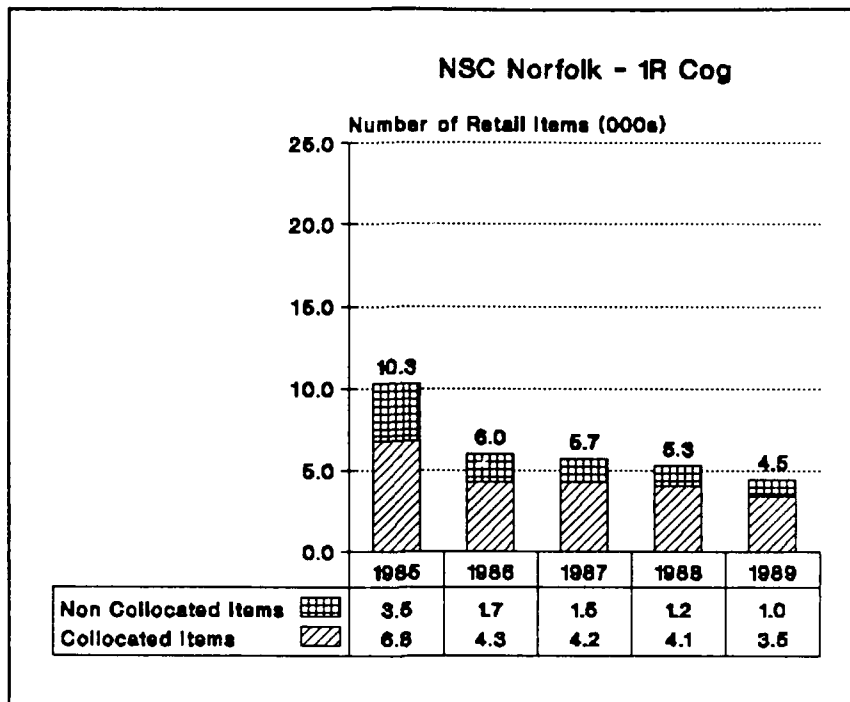


Figure 15

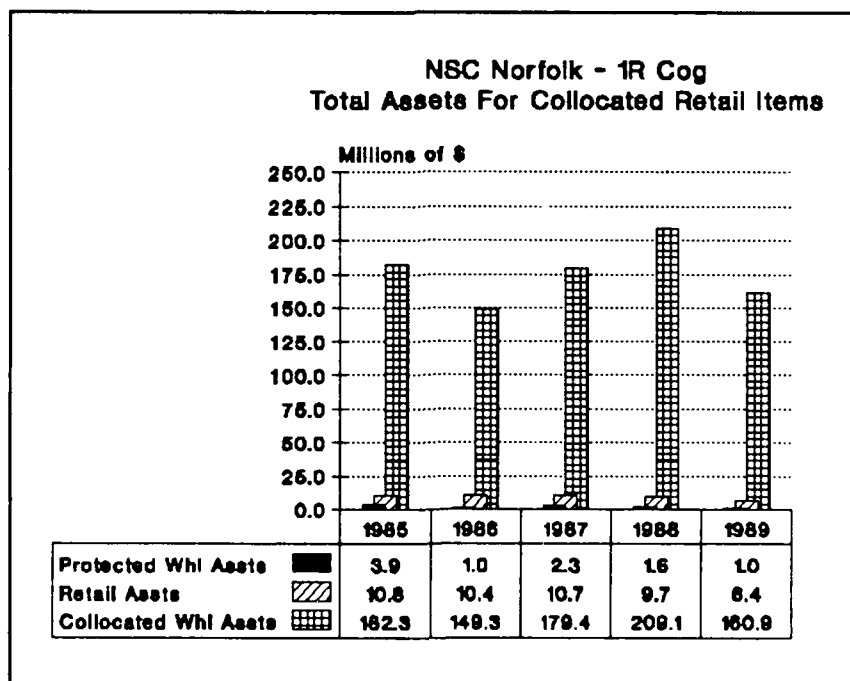


Figure 16

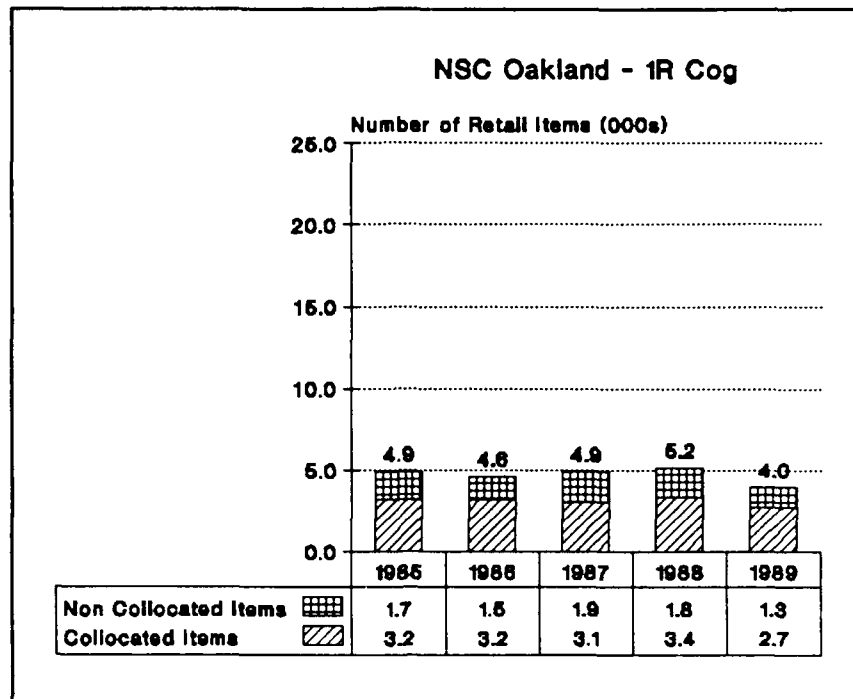


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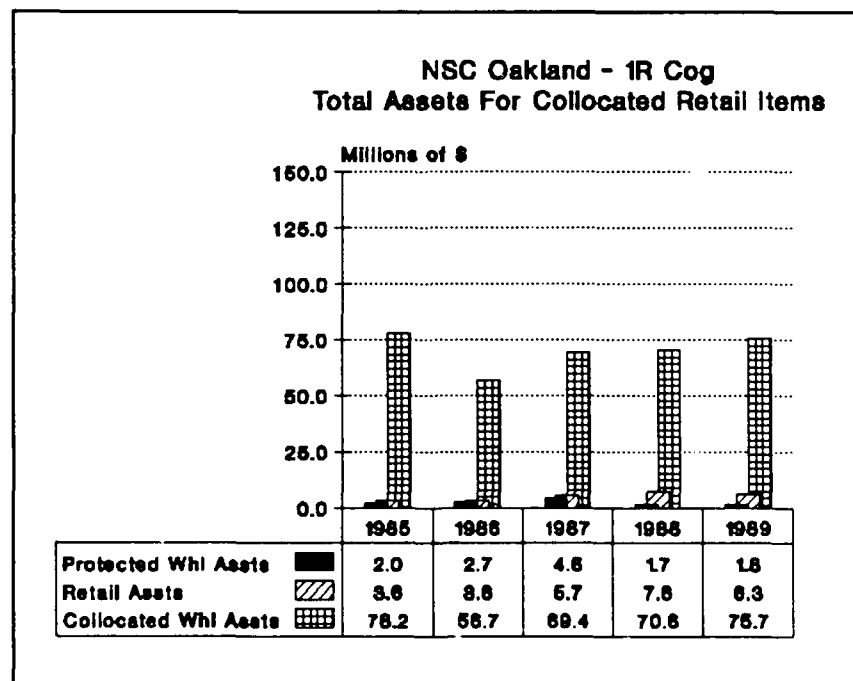


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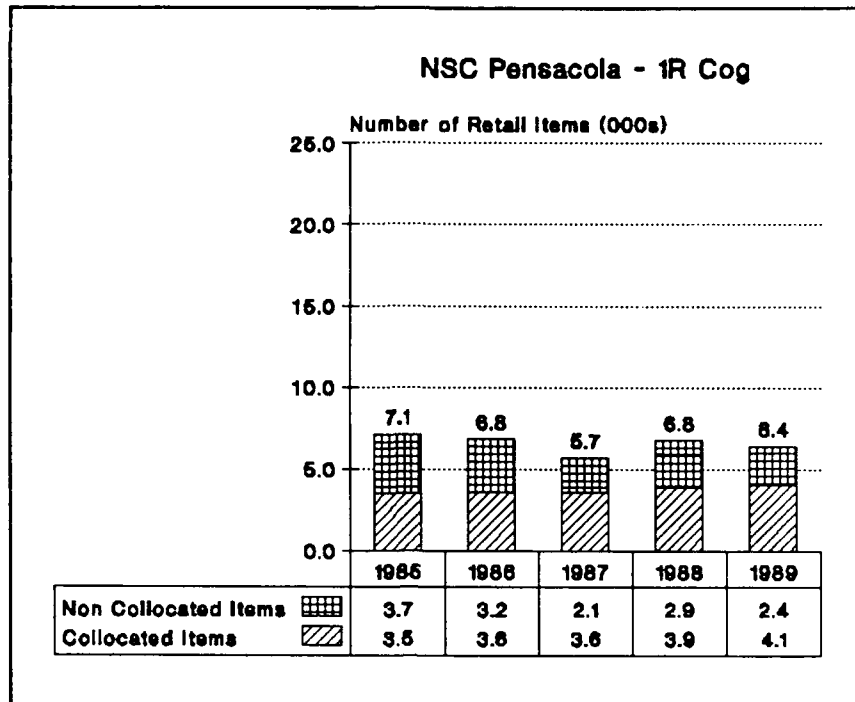


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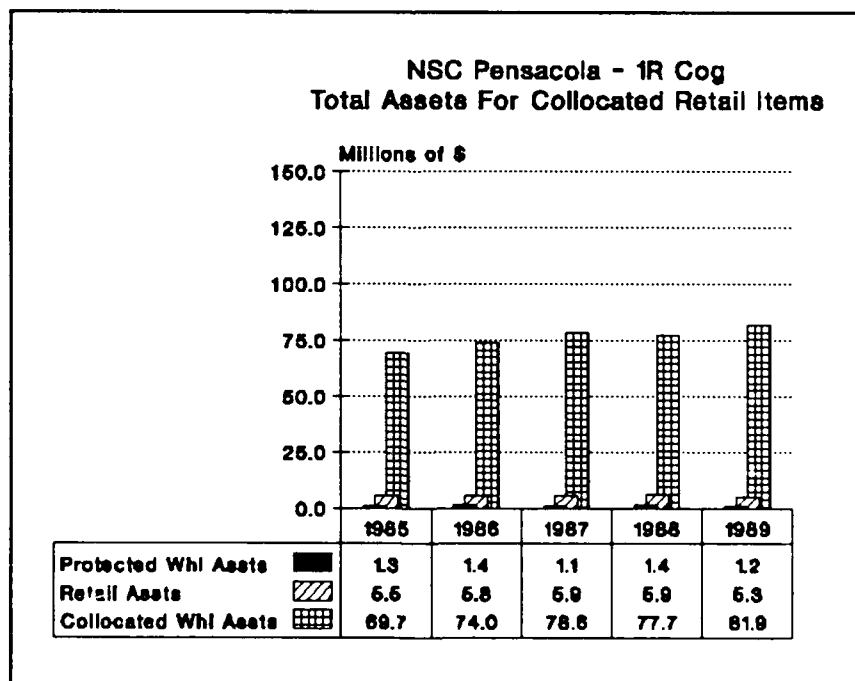


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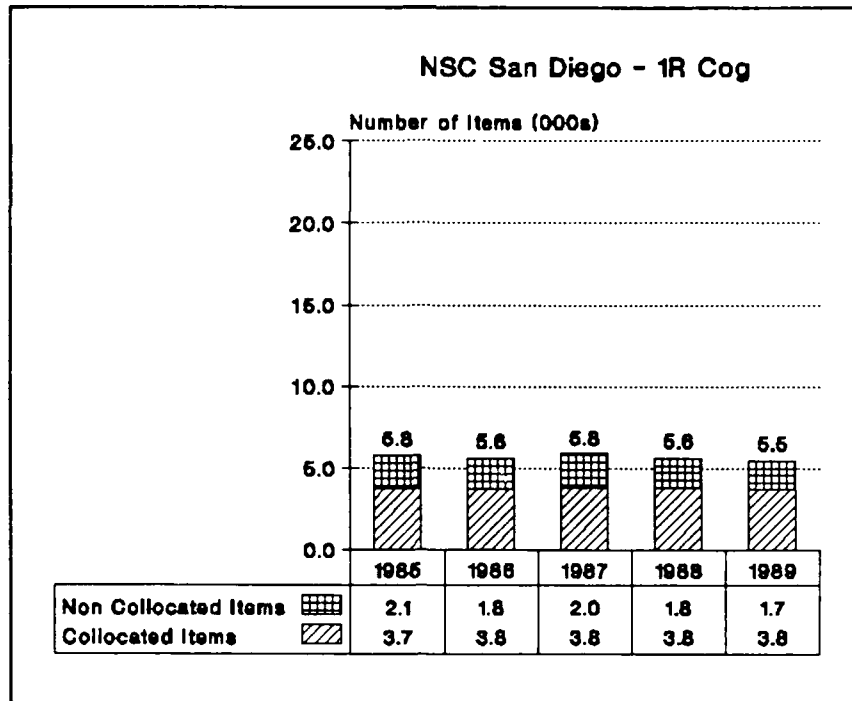


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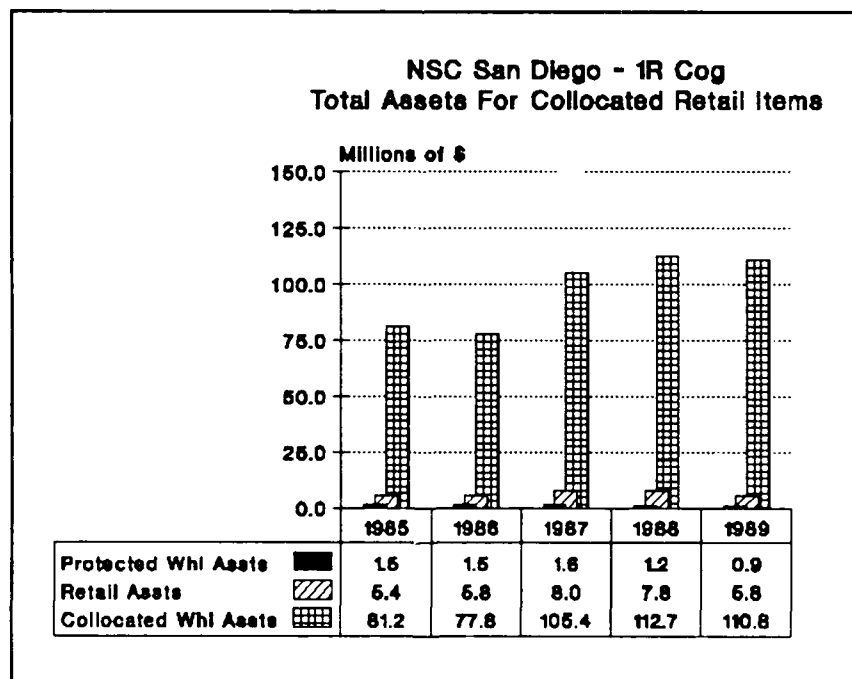


Figure 22

## APPENDIX C: IMPACT ON INTERMEDIATE INVENTORY

The graphs displayed in FIGURES 1 through 24 show for each of the four types of items (demand-based collocated, nondemand-based collocated, demand-based noncollocated, and nondemand-based noncollocated items) various summary statistics for the activities within each Cog breakdown. The summary statistics include (1) the total number of retail NIINs of each type and their percentage of the total activity retail NIINs, and (2) the dollar value and percentage of total dollar value for each type of retail NIIN for the total assets, protected wholesale requirements, retail requirements, total requirements, and collocated wholesale assets. The following is the order in which the figures appear in this appendix:

<u>Figure</u>	<u>Page</u>
Figure 1 - 1H Cog, Jan 1989, Total Retail NIINs	C-3
Figure 2 - 1H Cog, Jan 1989, Percent of Total Retail NIINs	C-3
Figure 3 - 1H Cog, Jan 1989, Total Assets	C-4
Figure 4 - 1H Cog, Jan 1989, Percent of Total Assets	C-4
Figure 5 - 1H Cog, Jan 1989, Protected Wholesale Requirements	C-5
Figure 6 - 1H Cog, Jan 1989, Percent of Protected Wholesale Requirements	C-5
Figure 7 - 1H Cog, Jan 1989, Retail Requirements	C-6
Figure 8 - 1H Cog, Jan 1989, Percent of Retail Requirements	C-6
Figure 9 - 1H Cog, Jan 1989, Total Requirements	C-7
Figure 10 - 1H Cog, Jan 1989, Percent of Total Requirements	C-7
Figure 11 - 1H Cog, Jan 1989, Collocated Wholesale Assets	C-8
Figure 12 - 1H Cog, Jan 1989, Percent of Collocated Wholesale Assets	C-8

Figure 13 - 1R Cog, Jan 1989, Total Retail NIINs	C-9
Figure 14 - 1R Cog, Jan 1989, Percent of Total Retail NIINs	C-9
Figure 15 - 1R Cog, Jan 1989, Total Assets	C-10
Figure 16 - 1R Cog, Jan 1989, Percent of Total Assets	C-10
Figure 17 - 1R Cog, Jan 1989, Protected Wholesale Requirements	C-11
Figure 18 - 1R Cog, Jan 1989, Percent of Protected Wholesale Requirements	C-11
Figure 19 - 1R Cog, Jan 1989, Retail Requirements	C-12
Figure 20 - 1R Cog, Jan 1989, Percent of Retail Requirements	C-12
Figure 21 - 1R Cog, Jan 1989, Total Requirements	C-13
Figure 22 - 1R Cog, Jan 1989, Percent of Total Requirements	C-13
Figure 23 - 1R Cog, Jan 1989, Collocated Wholesale Assets	C-14
Figure 24 - 1R Cog, Jan 1989, Percent of Collocated Wholesale Assets	C-14

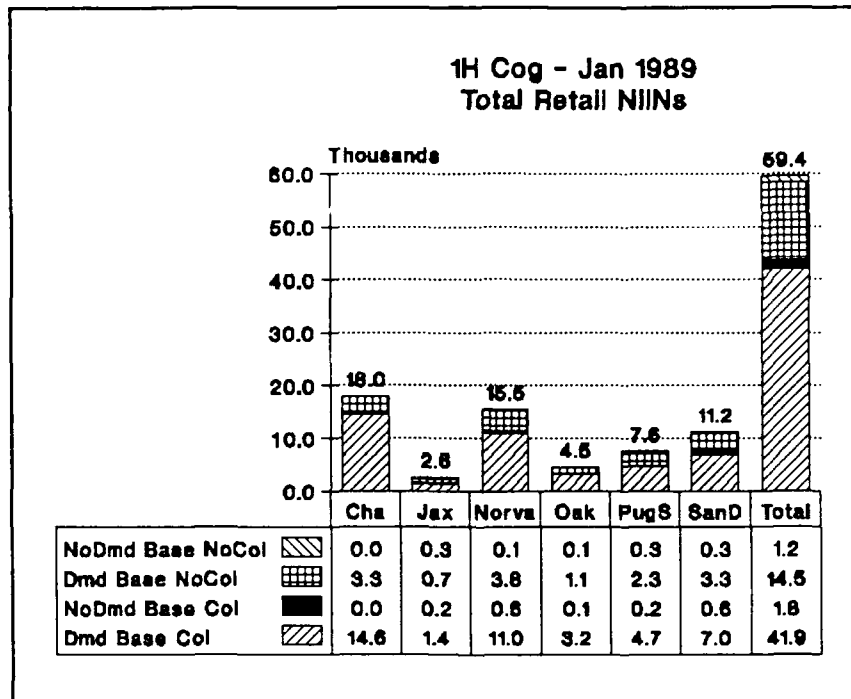


Figure 1

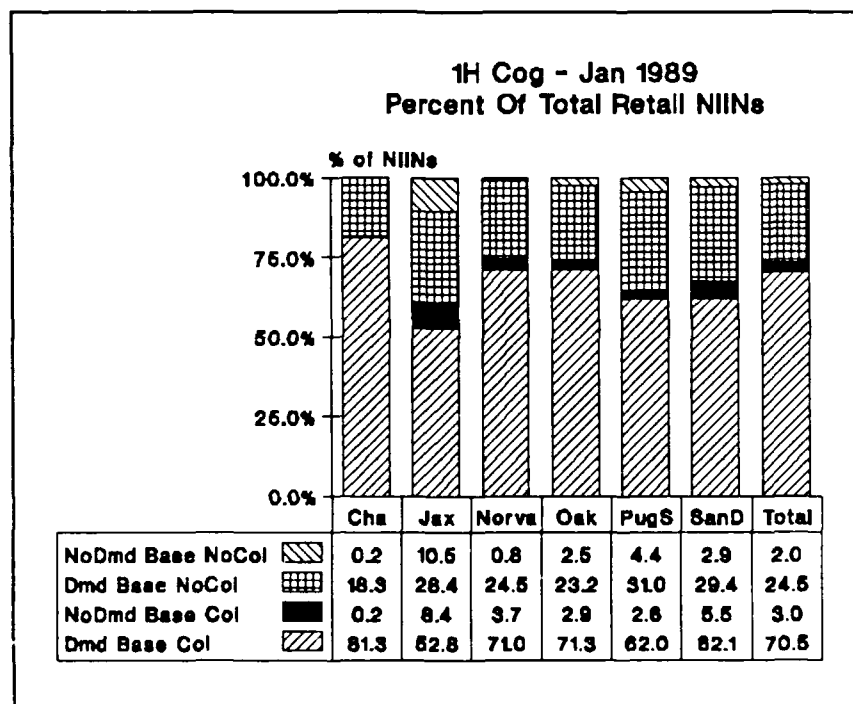


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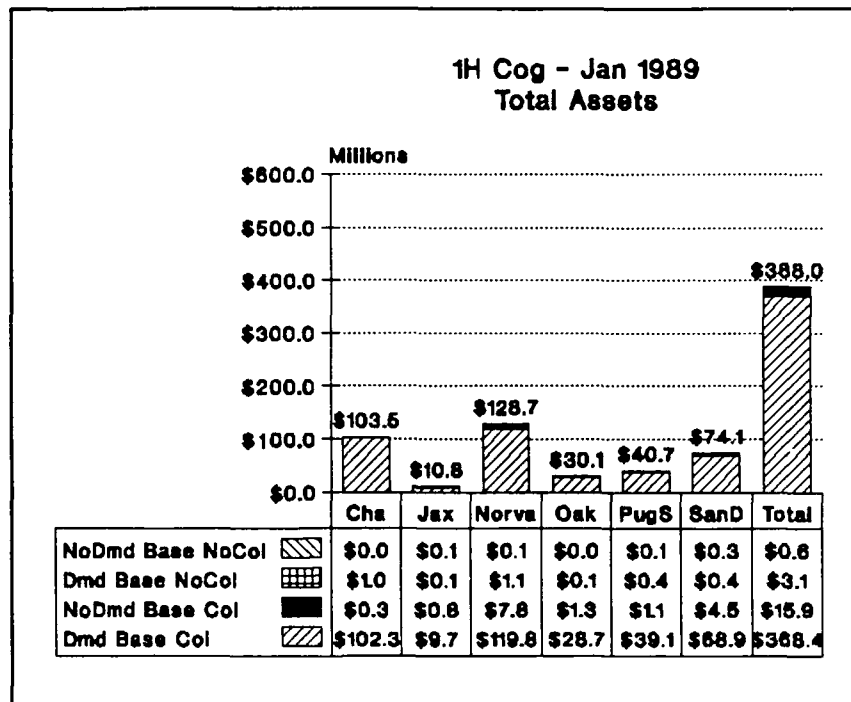


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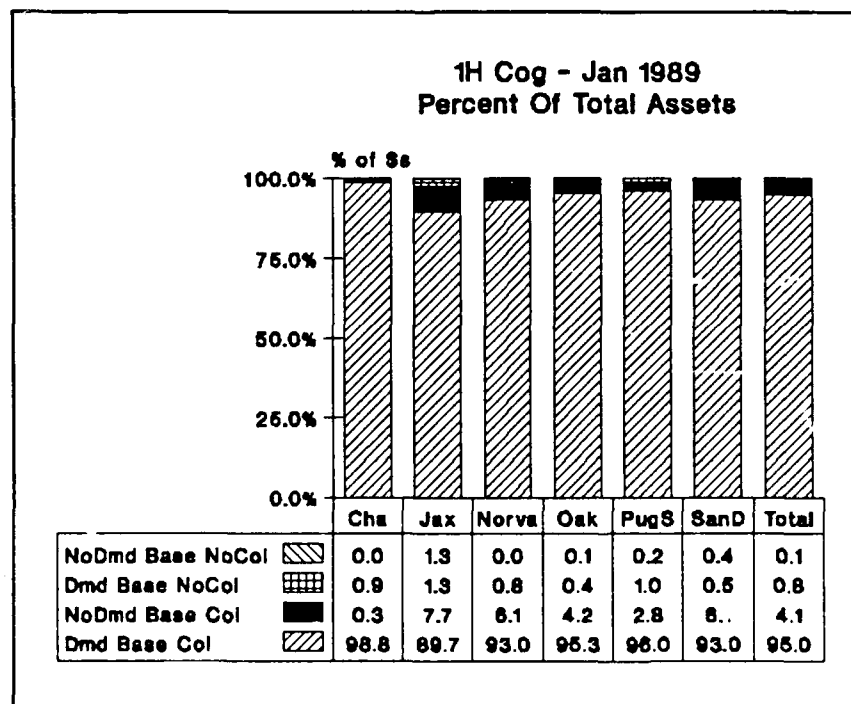


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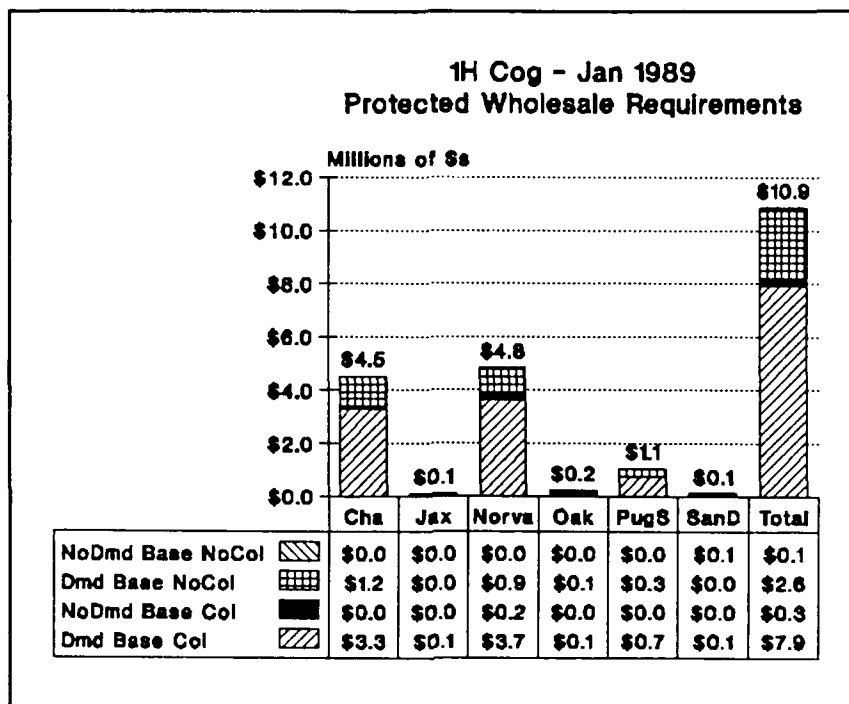


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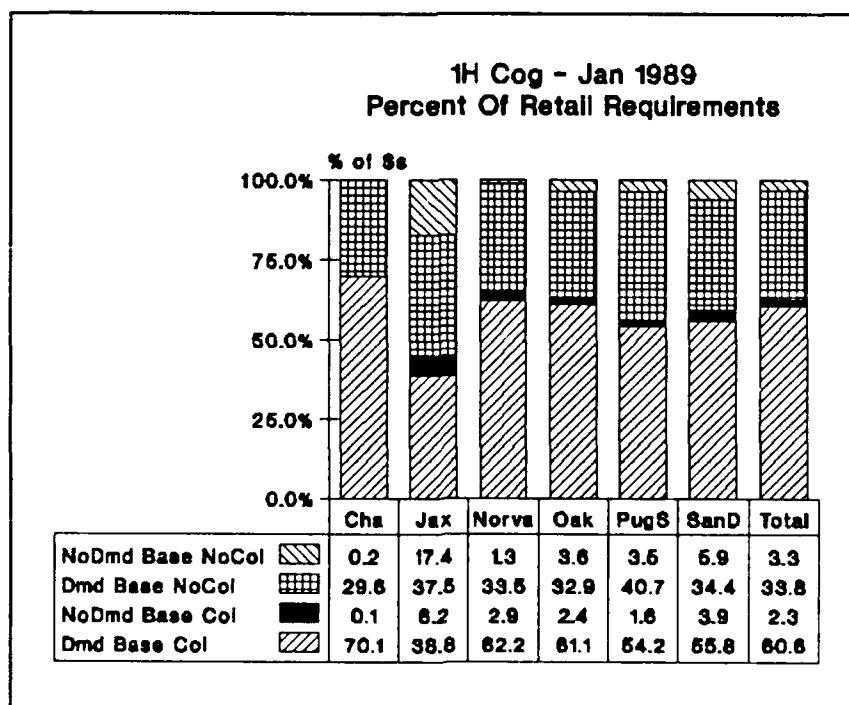


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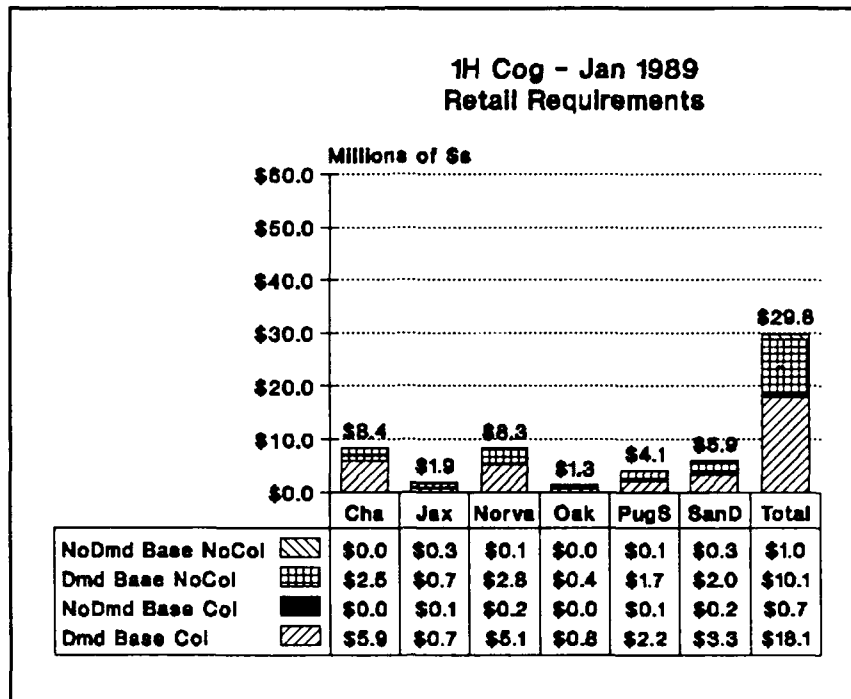


Figure 7

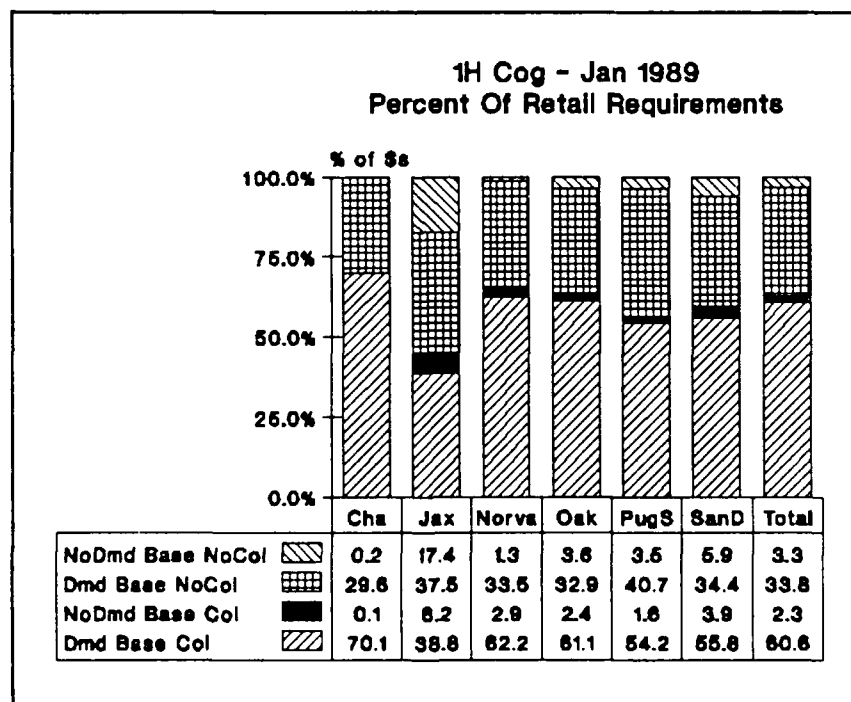


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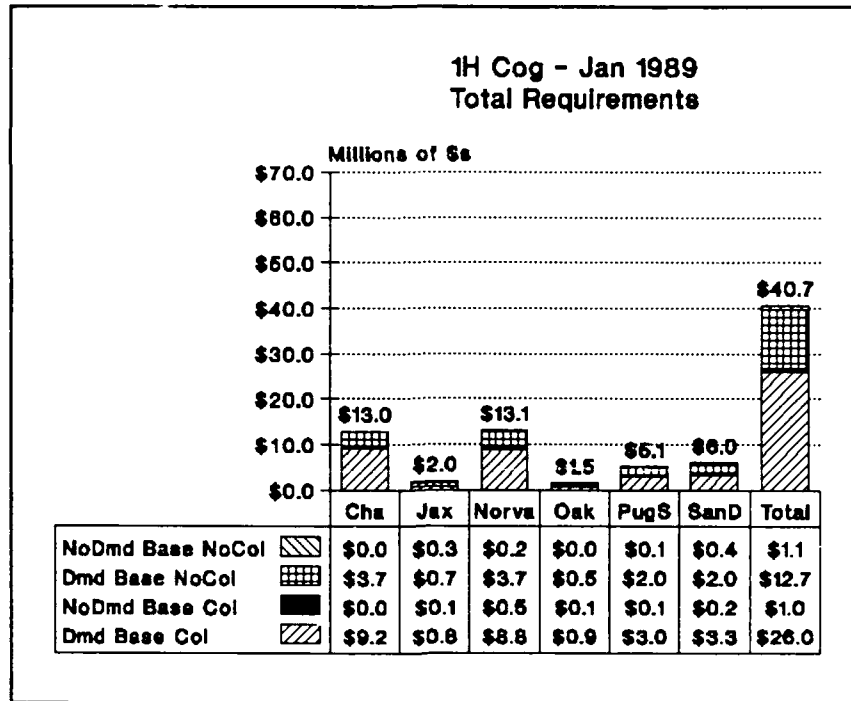


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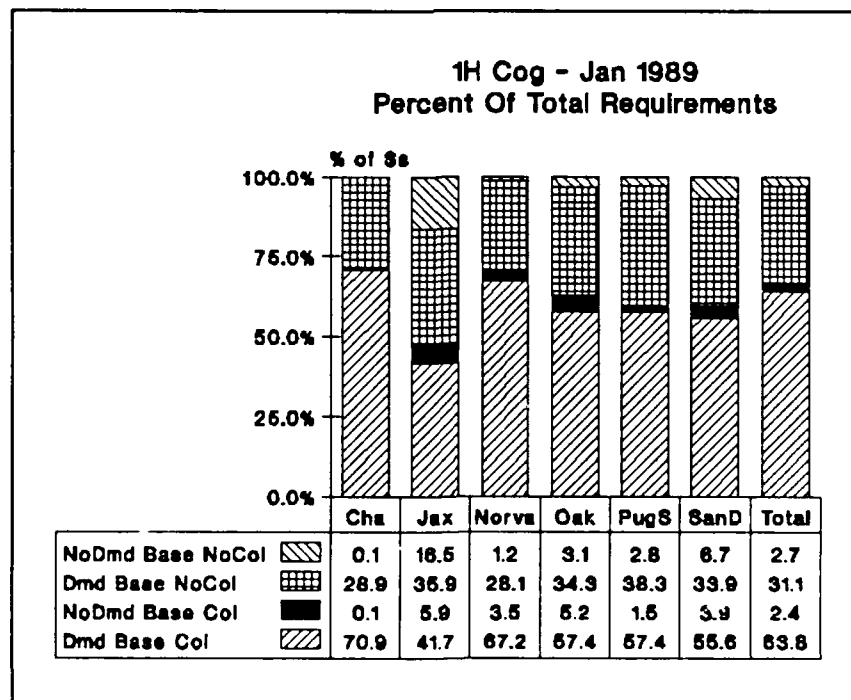


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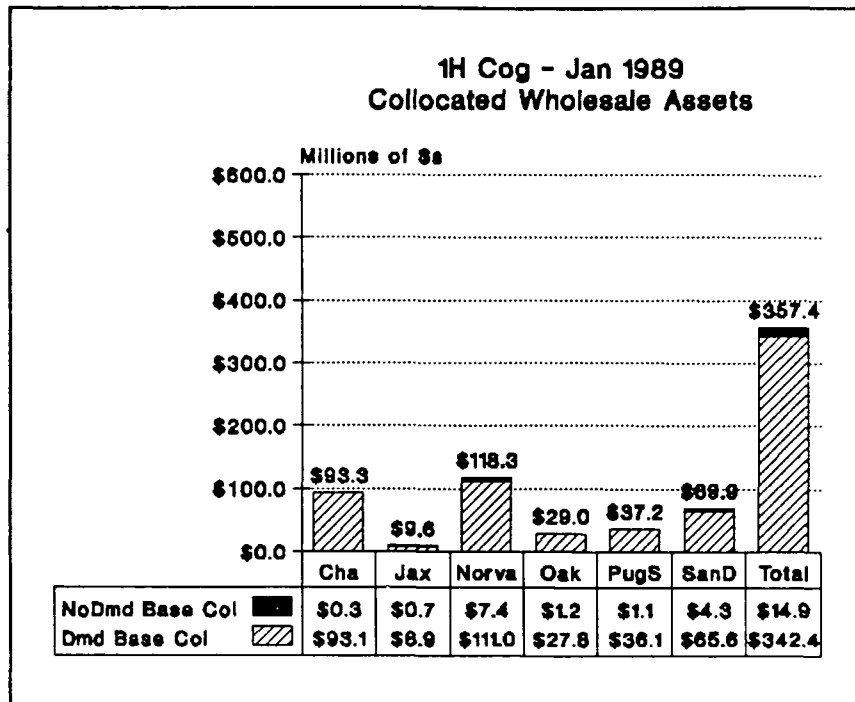


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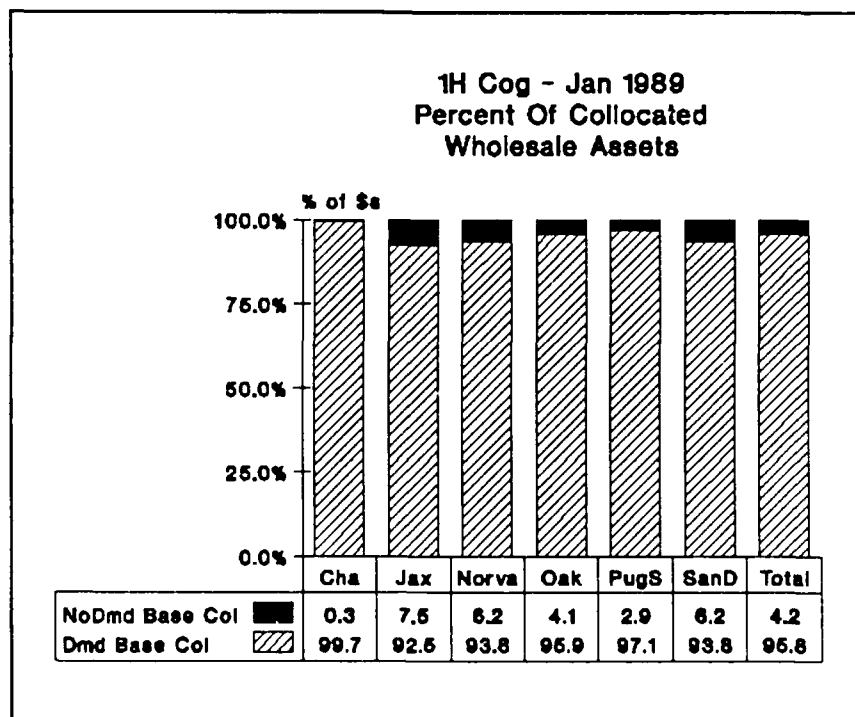


Figure 12

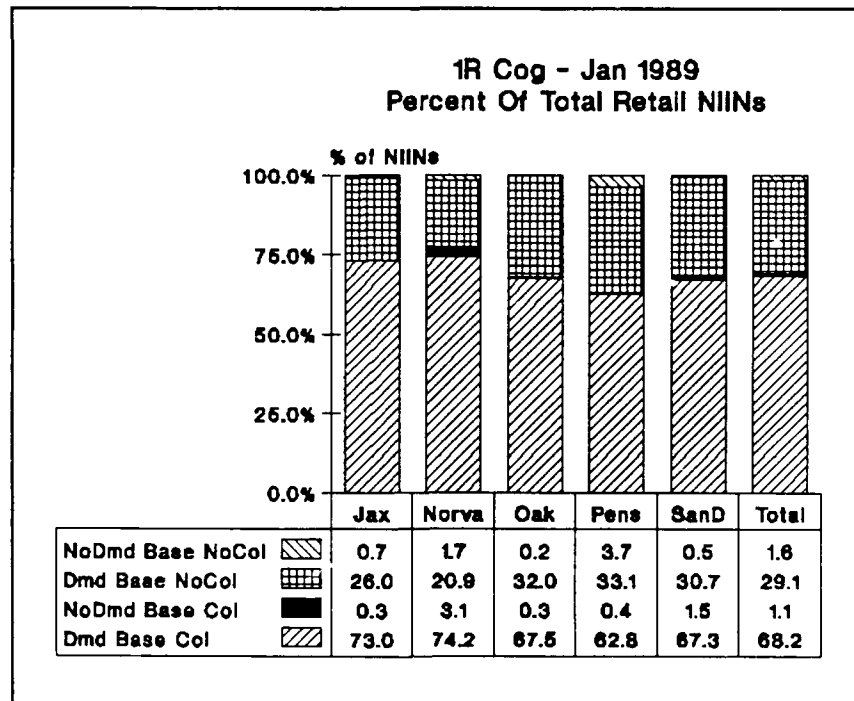


Figure 13

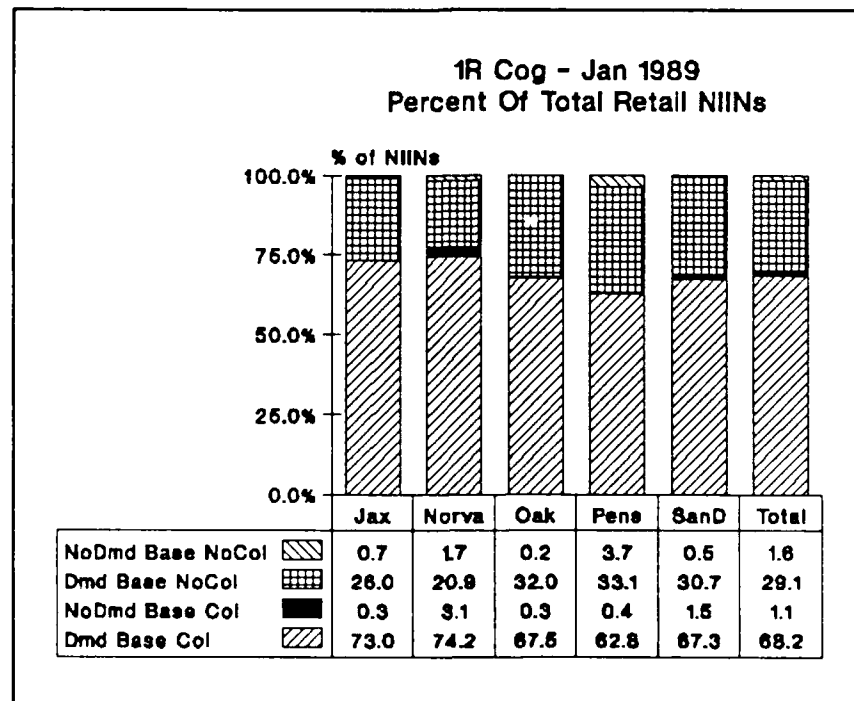


Figure 14

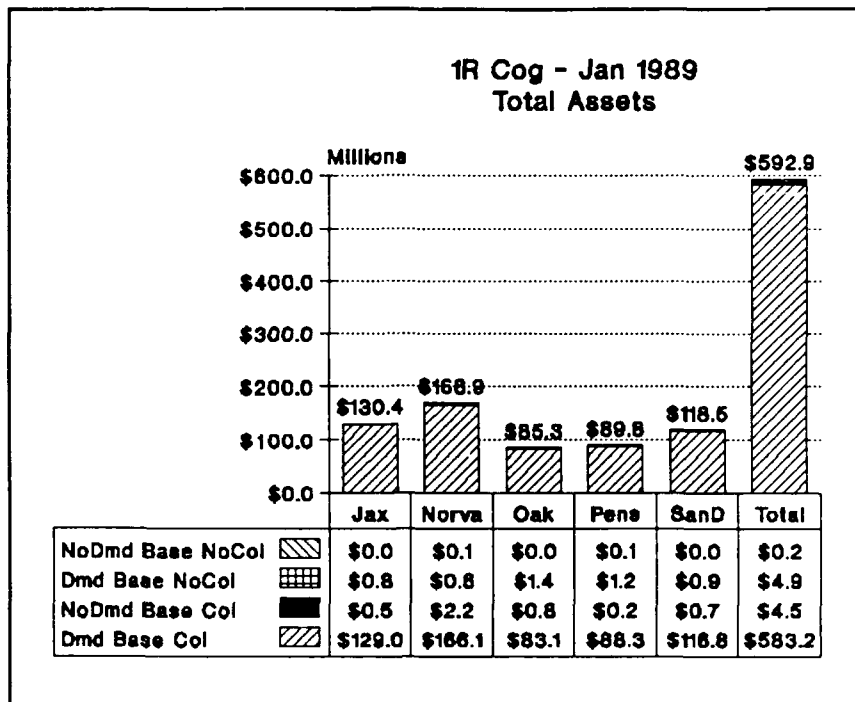


Figure 15

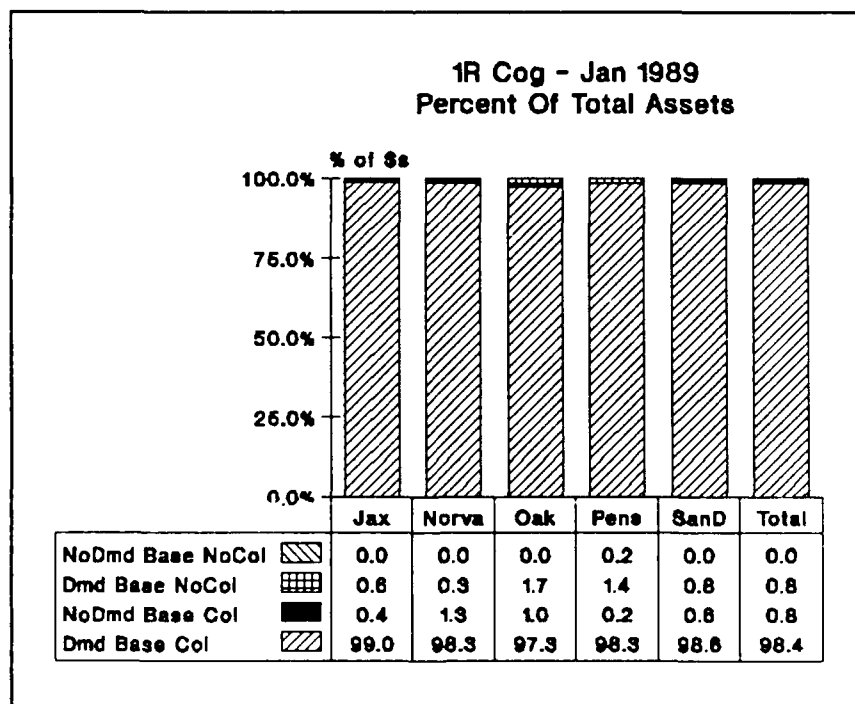


Figure 16

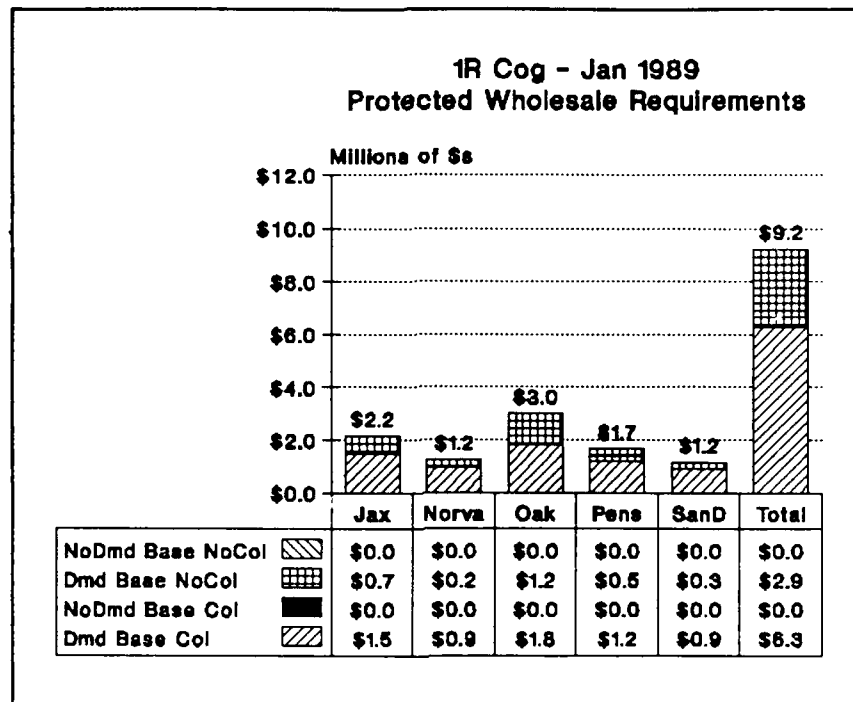


Figure 17

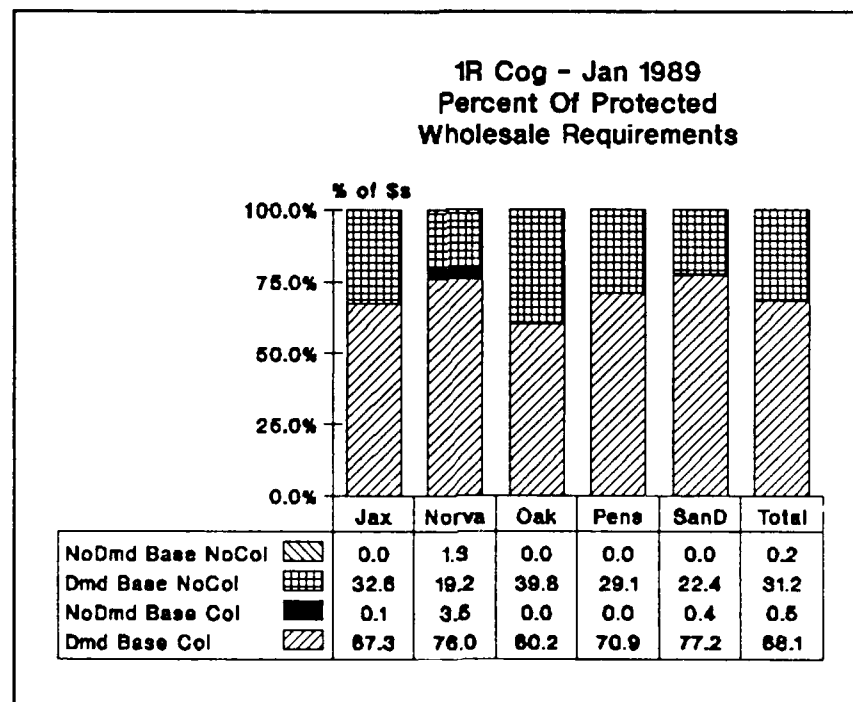


Figure 18

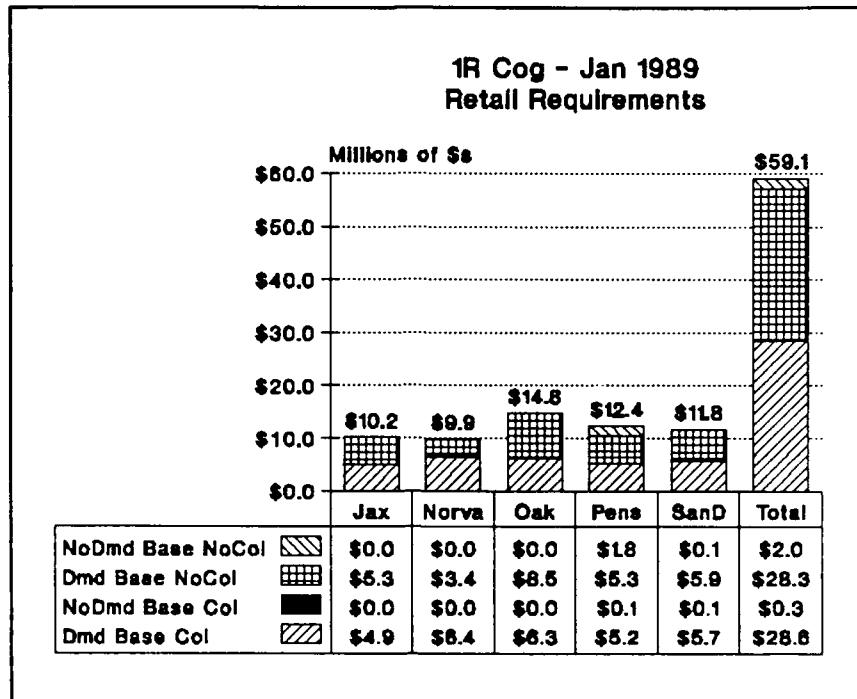


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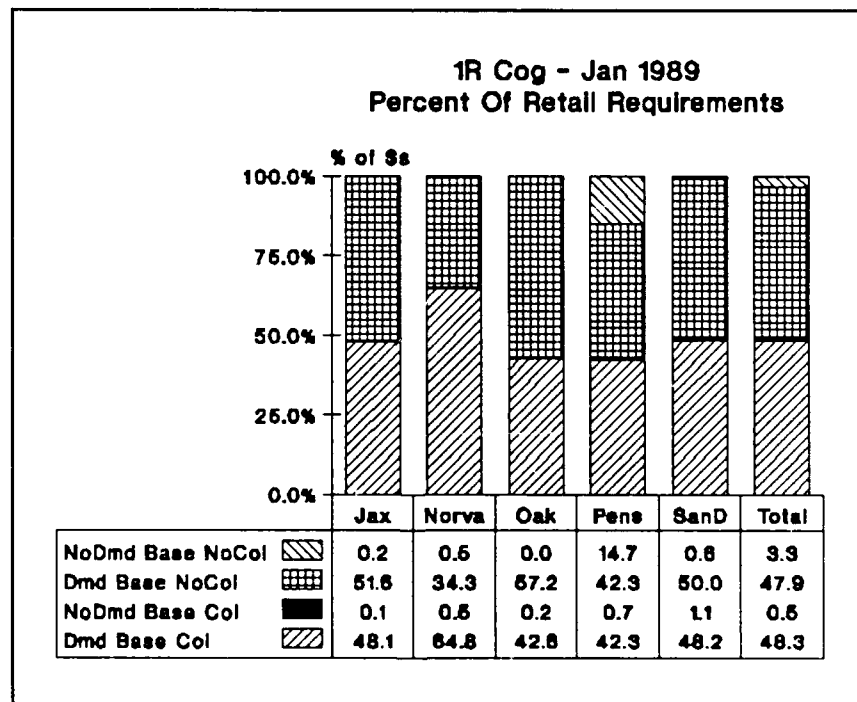


Figure 20



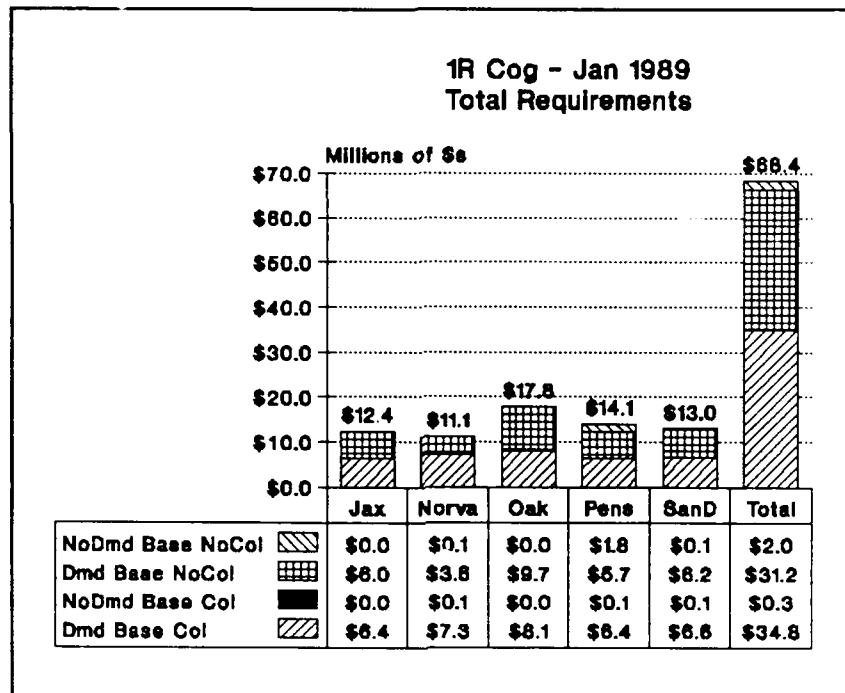


Figure 21

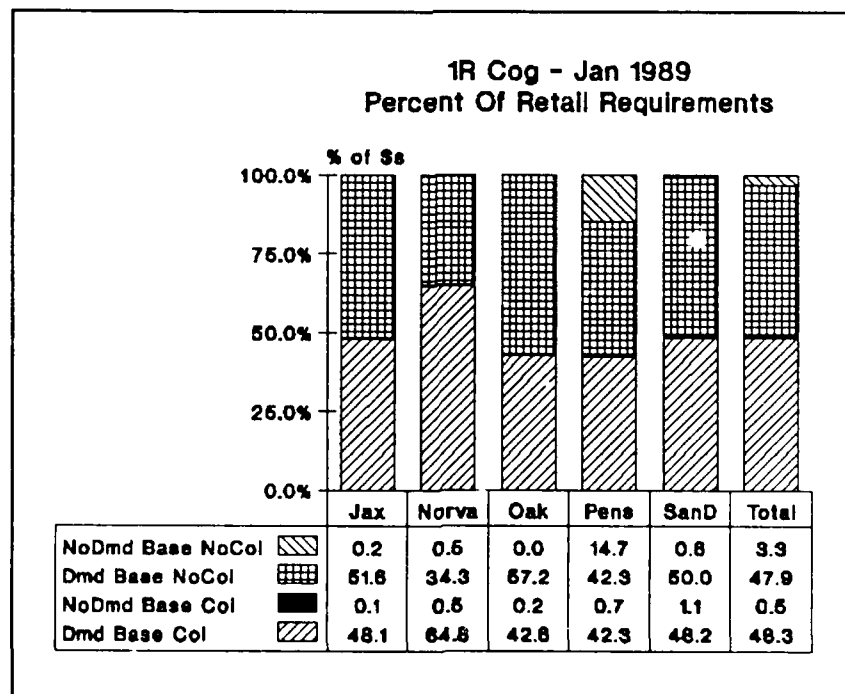


Figure 22

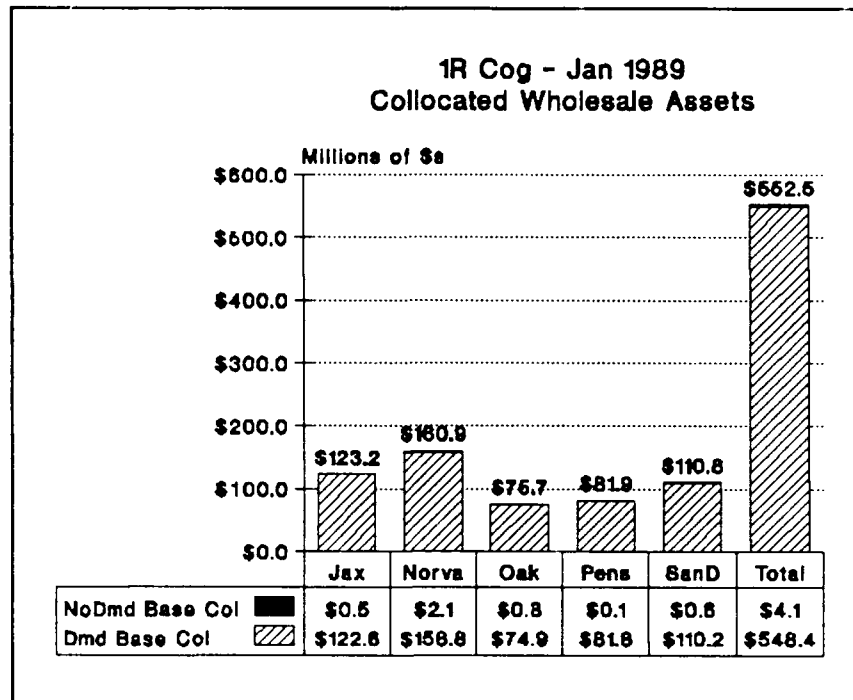


Figure 23

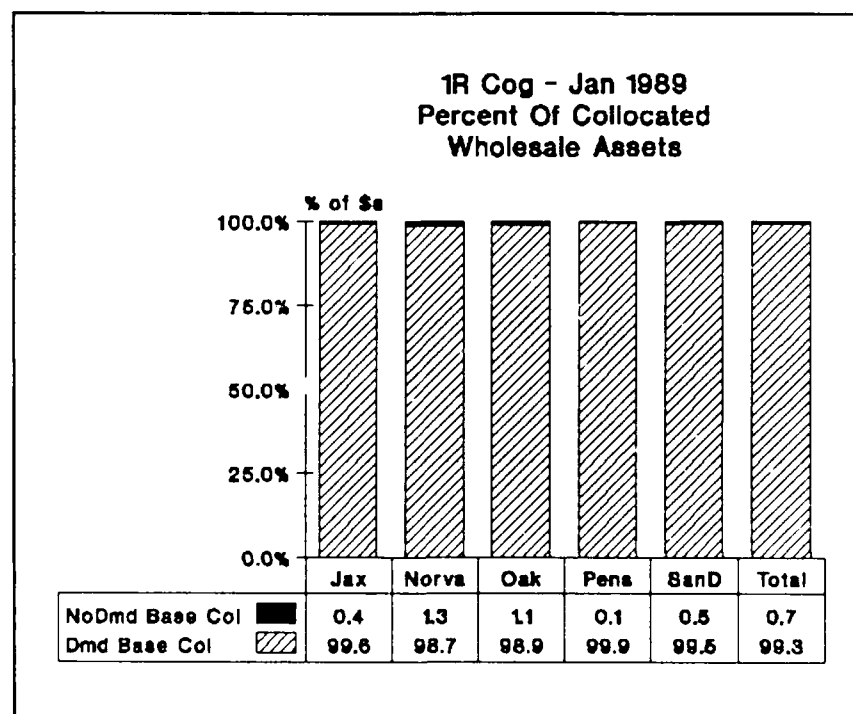


Figure 24

## APPENDIX D: IMPACT ON ACWT

The tables in this appendix provide the data values for the Average Customer Wait Time (ACWT) calculations. Figures 1 and 2 are examples of the ACWT Decision Tree computations, using the data from the tables. We produced graphs of the ACWT data, both system-wide and by individual NSC. Each graph contains groups of three comparative bars: the shortest bar represents baseline ACWT, the middle bar represents ACWT after the elimination of retail for collocated items only, and the tallest bar represents ACWT after the total elimination of retail. To help explain the impact of IPG III requisitions on ACWT, Figures 3 through 6 show ACWT computed with and without (shown as adjacent bars for each statistic) the Issue Priority Group (IPG) III receipt data. The figures show that relative differences between ACWT are maintained regardless of whether IPG III requisitions are included or not. In fact, the inclusion of IPG III requisitions inflates the ACWT by at most 7% for 1H Cog and 4% for 1R Cog NADEP customers. Thus, it may not always be necessary to remove the IPG III requisitions when computing ACWT. Despite this finding, we did not include IPG III requisitions in any tables used to derive the impact on system ACWT or costs to increase wholesale levels to maintain the current ACWT. Figures 7 and 8 are graphs of the 75th percentile ACWT (each NSC is shown within a chart) for non-Shipboard Automated Data Processing System (SUADPS) customers (1H Cog) and for NADEP customers (1R Cog), respectively. Figures 9 through 12 are graphs of 1H Cog median ACWT (all NSCs are shown within a chart) for both SUADPS and non-SUADPS customers, and for ACWT computed with and without the consumer echelon in the Decision Tree calculation. Similarly, figures 13 through 16 are graphs of 1R Cog median ACWT both for SUADPS customers (with special consideration given to the "lock-out", depicted in the Figure 2 Decision Tree) and for NADEP customers.

<u>Table/Figure</u>	<u>Page</u>
Table I - POE Input	D-4
Table II - Referral Effectiveness Input	D-4
Table III - Requisition Weighting Factors (RWF) Input	D-4
Table IV - Median TRRT (Days) Input to ACWT Calculations	D-5
Table V - Mean TRRT (Days) Input to ACWT Calculations	D-6
Table VI - 75th Percentile TRRT (Days) Input to ACWT Calculations	D-7
Figure 1 - Example of ACWT Decision Tree Computation	D-8
Figure 2 - Example of ACWT Decision Tree Computation w/1R "Lockout"	D-8
Figure 3 - 1H Cog System ACWT Statistics IPG I/II vs. IPG Total, SUADPS	D-9
Figure 4 - 1H Cog System ACWT Statistics IPG I/II vs. IPG Total, Non-SUADPS	D-9
Figure 5 - 1R Cog System ACWT Statistics IPG I/II vs. IPG Total, SUADPS	D-10
Figure 6 - 1R Cog System ACWT Statistics IPG I/II vs. IPG Total, NADEPs	D-10
Figure 7 - 1H Cog NSCs 75th Percentile ACWT IPG I/II, Non-SUADPS	D-11
Figure 8 - 1R Cog NSCs 75th Percentile ACWT IPG I/II, NADEPs	D-11
Figure 9 - 1H Cog NSCs Median ACWT, IPG I/II, SUADPS	D-12
Figure 10 - 1H Cog NSCs Median ACWT, IPG I/II, Non-SUADPS	D-12

Figure 11 - 1H Cog NSCs Median ACWT w/o Consumer Level Inventory	
IPG I/II, SUADPS	D-13
Figure 12 - 1H Cog NSCs Median ACWT w/o Consumer Level Inventory	
IPG I/II, Non-SUADPS	D-13
Figure 13 - 1R Cog NSCs Median ACWT, IPG I/II, SUADPS	D-14
Figure 14 - 1R Cog NSCs Median ACWT, IPG I/II, NADEPs	D-14
Figure 15 - 1R Cog NSCs Median ACWT w/o Consumer Level Inventory	
IPG I/II, SUADPS	D-15
Figure 16 - 1R Cog NSCs Median ACWT w/o Consumer Level Inventory	
IPG I/II, NADEPs	D-15

TABLE I  
POE Input

COG	FY	CHA	JAX	NORVA	OAK	PEN	PUG S	SAN D	NSC TOTAL
1H	FY88	.777	.481	.679	.543	N/A	.655	.555	.650
	FY81	.656	.382	.508	.337		.274	.378	.472
1R	FY88	N/A	.598	.685	.585	.643	N/A	.620	.629
	FY81		.525	.522	.439	.462		.493	.491

TABLE II  
Referral Effectiveness Input

COG	FY	CHA	JAX	NORVA	OAK	PEN	PUG S	SAN D	NSC TOTAL
1H	FY88	.377	.732	.567	.696	N/A	.597	.688	.603
	FY81	.308	.615	.516	.641		.672	.617	.549
1R	FY88	N/A	.537	.410	.552	.479	N/A	.511	.499
	FY81		.564	.567	.631	.615		.592	.593

TABLE III  
Requisition Weighting Factors (RWF) Input

	CHA	JAX	NORVA	OAK	PEN	PUG S	SAN D	NSC TOTAL
1H	.784	.606	.715	.740	N/A	.647	.667	.716
1R	N/A	.624	.656	.536	.534	N/A	.533	.567

TABLE IV

## MEDIAN TRRT (DAYS) INPUT TO ACWT CALCULATIONS

TOT PEON RESP TIME (DAYS: H-TPT REPORT)	CHX SUROPS MEDIAN	JAX SUROPS MEDIAN	NORVA SUROPS MEDIAN	ONK SUROPS MEDIAN	PEN SUROPS MEDIAN	PUG S SUROPS MEDIAN	SAN D SUROPS MEDIAN	TOTAL SUROPS MEDIAN
1H COG IPG I + II								
POE IMM ISS	22.1	35.2	32.0	66.9	N/A	52.5	22.7	25.4
REF IMM ISS	29.3	44.4	41.3	74.4	N/A	65.5	24.5	33.8
BACKORDERS	120.7	162.7	144.6	180.5	N/A	165.5	144.8	139.5
1H COG ALL IPGS								
POE IMM ISS	24.4	33.9	34.4	66.5	N/A	58.5	27.6	28.0
REF IMM ISS	31.0	47.0	41.9	72.2	N/A	70.5	27.7	35.5
BACKORDERS	120.3	165.2	148.0	179.6	N/A	163.0	142.3	141.8
1P COG IPG I + II								
POE IMM ISS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
REF IMM ISS	N/A	45.5	33.1	43.6	68.0	N/A	48.2	37.4
BACKORDERS	N/A	225.3	120.5	126.0	136.0	N/A	119.1	122.0
1P COG ALL IPGS								
POE IMM ISS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
REF IMM ISS	N/A	48.0	40.1	46.9	83.0	N/A	66.1	47.1
BACKORDERS	N/A	231.0	116.9	131.2	122.0	N/A	143.4	129.6
TOT PEON RESP TIME (DAYS: H-TPT REPORT)								
CHX SUROPS MEDIAN		JAX SUROPS MEDIAN	NORVA SUROPS MEDIAN	ONK SUROPS MEDIAN	PEN SUROPS MEDIAN	PUG S SUROPS MEDIAN	SAN D SUROPS MEDIAN	TOTAL SUROPS MEDIAN
1H COG IPG I + II								
POE IMM ISS	15.8	10.5	11.0	12.2	N/A	8.6	19.7	11.6
REF IMM ISS	12.0	6.0	16.9	12.1	N/A	12.4	21.7	16.0
BACKORDERS	155.5	168.0	131.3	129.0	N/A	134.6	167.8	139.6
1H COG ALL IPGS								
POE IMM ISS	15.7	16.5	13.9	13.9	N/A	10.4	21.1	13.6
REF IMM ISS	17.5	7.8	21.9	13.7	N/A	14.8	23.9	20.5
BACKORDERS	145.5	90.5	130.0	138.5	N/A	134.1	165.4	137.9
1P COG IPG I + II								
POE IMM ISS	N/A	6.2	13.1	13.1	13.1	N/A	13.1	13.1
REF IMM ISS	N/A	13.6	21.0	24.9	17.9	N/A	13.1	17.9
BACKORDERS	N/A	84.9	150.2	131.7	127.5	N/A	118.6	127.5
1P COG ALL IPGS								
POE IMM ISS	N/A	14.2	14.1	14.3	14.1	N/A	14.1	14.1
REF IMM ISS	N/A	18.3	26.2	26.4	20.5	N/A	14.4	20.5
BACKORDERS	N/A	103.1	146.4	132.9	127.8	N/A	117.9	127.8

TABLE V

## MEAN TRRT (DAYS) INPUT TO ACWT CALCULATIONS

TUT	PHR	RESP TIME	CHH	JAX	NORVA	OAK	SHOPS	PER	PUG S	SAN D	TOTAL
SURPS	TRPT	REPORT	NON-S	MEAN	NON-S	MEAN	MEAN	MEAN	MEAN	MEAN	MEAN
1H	LOG	IPG I + II									
POE	IMM	ISS	28.9	41.7	37.9	67.2	N/A	N/A	56.9	33.7	32.9
REF	IMM	ISS	36.5	52.8	48.7	73.0	N/A	N/A	73.3	33.0	43.5
BACKORDERS			142.5	166.7	158.8	186.5	N/A	N/A	184.6	155.8	154.8
1H	COG	ALL IPGS									
POE	IMM	ISS	30.1	41.6	40.8	68.6	N/A	N/A	62.7	37.2	35.4
REF	IMM	ISS	40.6	56.9	49.2	71.8	N/A	N/A	75.3	35.5	45.3
BACKORDERS			142.4	170.3	162.1	186.4	N/A	N/A	182.8	155.2	156.6
1R	COG	IPG I + II									
POE	IMM	ISS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
REF	IMM	ISS	N/A	63.6	40.9	47.9	69.8	N/A	N/A	58.3	45.7
BACKORDERS			N/A	240.4	131.3	147.2	152.5	N/A	N/A	141.7	138.2
1R	COG	ALL IPGS									
POE	IMM	ISS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
REF	IMM	ISS	N/A	63.2	47.2	52.9	76.5	N/A	N/A	68.2	53.8
BACKORDERS			N/A	291.5	133.2	154.3	138.2	N/A	N/A	152.8	146.3
TUT	PHR	RESP TIME	CHH	JAX	NORVA	OAK	SHOPS	PER	PUG S	SAN D	TOTAL
DAYS:M-TRPT	REPORT	NON-S	MEAN	NON-S	MEAN	MEAN	MEAN	MEAN	MEAN	MEAN	MEAN
1H	LOG	IPG I + II									
POE	IMM	ISS	17.1	21.9	14.8	14.4	N/A	N/A	10.4	23.2	15.7
REF	IMM	ISS	20.4	12.8	24.1	17.9	N/A	N/A	20.7	27.7	25.2
BACKORDERS			163.1	74.7	149.2	155.9	N/A	N/A	152.0	173.2	157.2
1H	COG	ALL IPGS									
POE	IMM	ISS	17.2	23.2	19.5	16.9	N/A	N/A	13.3	25.2	17.2
REF	IMM	ISS	23.8	17.3	30.0	19.8	N/A	N/A	24.1	29.9	29.5
BACKORDERS			152.5	132.5	150.0	161.5	N/A	N/A	147.1	170.0	155.1
1R	COG	IPG I + II									
POE	IMM	ISS	N/A	15.3	16.9	16.7	N/A	N/A	N/A	16.9	16.9
REF	IMM	ISS	N/A	18.7	27.0	48.0	34.3	N/A	N/A	18.3	34.3
BACKORDERS			N/A	120.8	163.9	151.2	146.8	N/A	N/A	136.6	146.8
1P	COG	ALL IPGS									
POE	IMM	ISS	N/A	18.7	18.1	17.9	18.1	N/A	N/A	18.1	18.1
REF	IMM	ISS	N/A	22.6	39.7	50.2	35.6	N/A	N/A	19.9	35.6
BACKORDERS			N/A	125.4	161.4	152.2	146.8	N/A	N/A	136.1	146.8



TABLE VI

## 75TH PERCENTILE TRRT (DAYS) INPUT TO ACWT CALCULATIONS

TOT REON RESP TIME (DAYS): TRRT REPORT	CHX	JAX	NORVA	ORX	PEN	PUG S	SHN D	TOTHL
	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %
1H CUG IPG I + II								
POE IMM ISS	33.4	48.9	47.4	85.9	N/A	68.7	38.6	40.0
REF IMM ISS	44.0	67.6	62.9	100.2	N/A	95.0	40.2	57.2
BACKORDERS	201.5	224.9	238.7	286.9	N/A	224.6	235.2	233.4
1H CUG ALL IPGS								
POE IMM ISS	34.9	52.4	51.7	86.4	N/A	78.1	44.9	43.4
REF IMM ISS	49.2	73.2	63.3	96.4	N/A	97.9	43.2	58.7
BACKORDERS	199.7	242.5	245.6	282.8	N/A	228.9	231.9	236.3
1P CUG IPG I + II								
POE IMM ISS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
REF IMM ISS	N/A	83.0	51.7	62.4	98.0	N/A	86.0	58.6
BACKORDERS	N/A	256.4	169.2	196.2	225.0	N/A	187.2	185.3
1P CUG ALL IPGS								
POE IMM ISS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
REF IMM ISS	N/A	74.9	62.3	66.9	109.2	N/A	92.5	71.9
BACKORDERS	N/A	352.3	168.8	209.5	185.3	N/A	188.8	191.5
TOT REON RESP TIME (DAYS): M-TRRT REPORT	CHX	JAX	NORVA	ORX	PEN	PUG S	SHN D	TOTHL
	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %	NON-S 75TH %
1H CUG IPG I + II								
POE IMM ISS	26.9	23.0	15.0	19.1	N/A	11.4	28.1	21.5
REF IMM ISS	21.9	9.9	25.8	20.2	N/A	18.4	30.6	29.9
BACKORDERS	230.6	95.5	201.1	230.0	N/A	219.4	233.5	224.9
1H CUG ALL IPGS								
POE IMM ISS	25.3	32.2	21.7	23.1	N/A	15.3	29.9	22.4
REF IMM ISS	23.7	17.6	36.8	22.8	N/A	23.7	33.8	34.0
BACKORDERS	206.9	223.5	207.0	232.2	N/A	205.2	234.2	217.6
1P CUG IPG I + II								
POE IMM ISS	N/A	14.5	19.3	19.2	19.3	N/A	19.3	19.3
REF IMM ISS	N/A	19.8	33.6	45.6	32.1	N/A	19.9	32.1
BACKORDERS	N/A	159.0	228.4	212.3	203.3	N/A	189.5	203.3
1P CUG ALL IPGS								
POE IMM ISS	N/A	23.4	21.6	21.2	21.6	N/A	21.6	21.6
REF IMM ISS	N/A	28.5	38.3	48.5	34.0	N/A	23.5	34.0
BACKORDERS	N/A	169.8	224.8	212.8	201.2	N/A	188.1	201.2

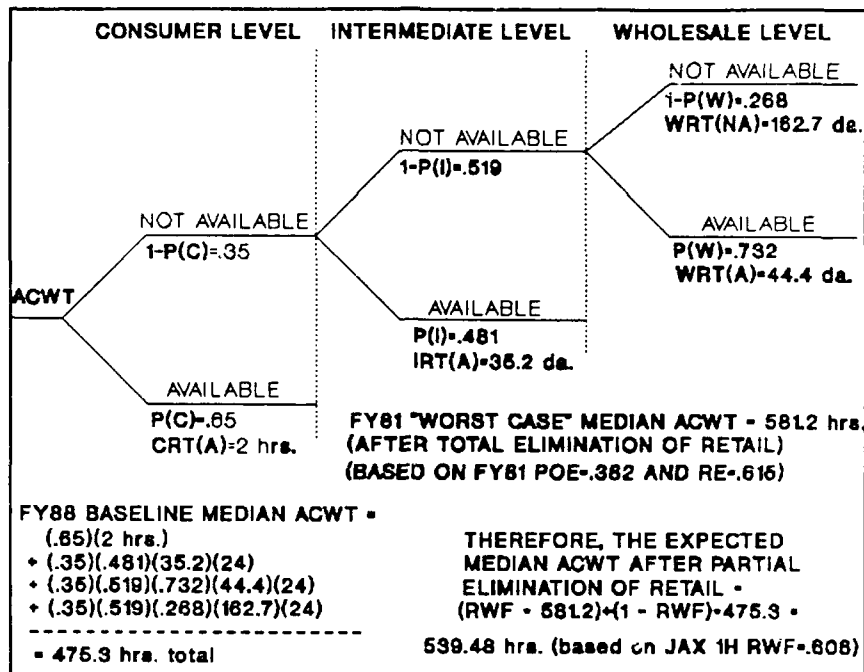


Figure 1 Decision Tree Calculation of 1H Cog Median ACWT for NSC Jacksonville, SUADPS Customers

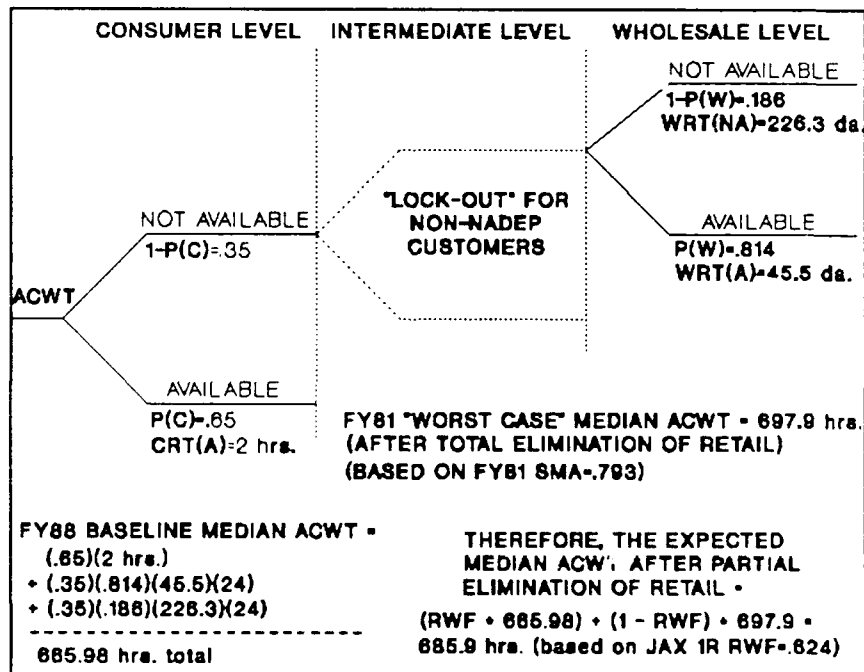


Figure 2 Decision Tree Calculation of 1R Cog Median ACWT (showing the "lock-out") for NSC Jacksonville, non-NADEP Customers

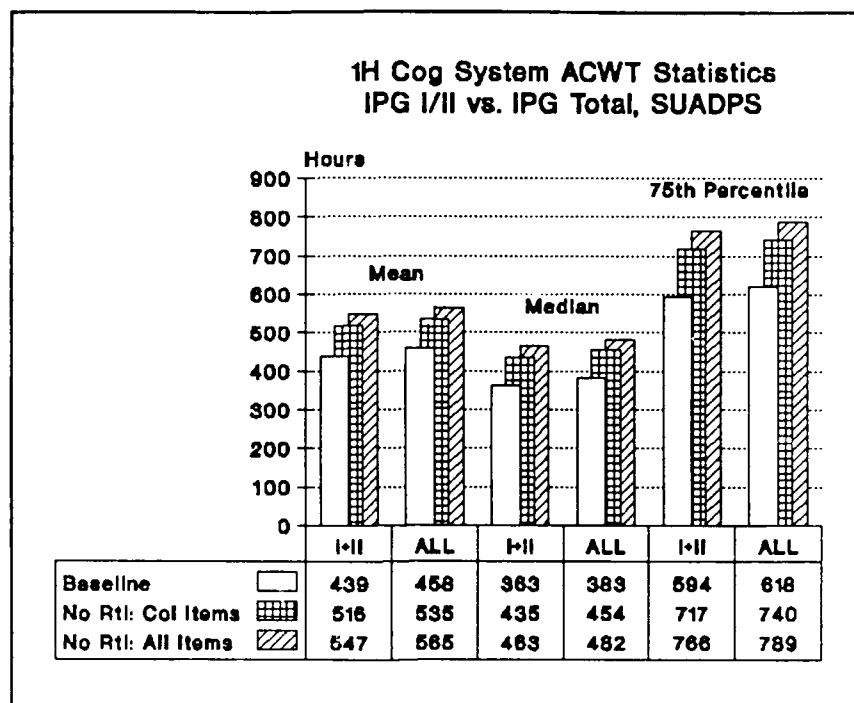


Figure 3 1H Cog System ACWT Statistics, IPG I/II vs. IPG Total, SUADPS

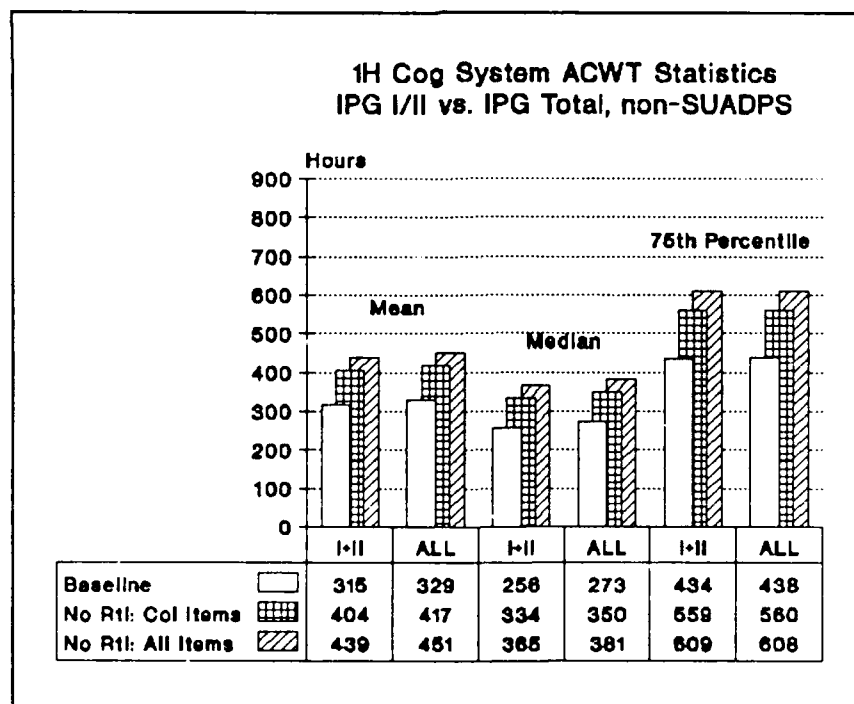


Figure 4 1H Cog System ACWT Statistics, IPG I/II vs. IPG Total, Non-SUADPS

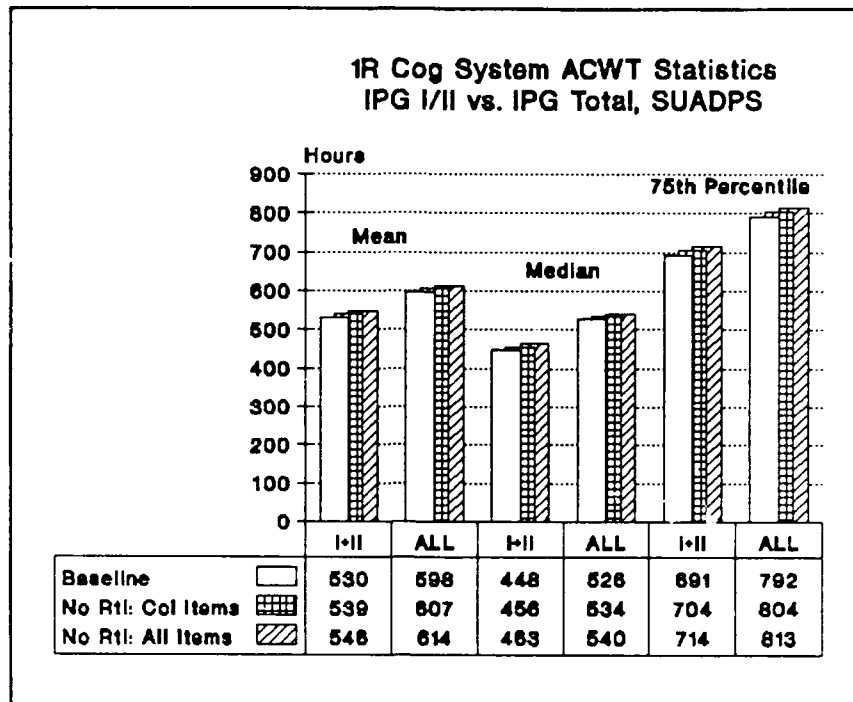


Figure 5 1R Cog System ACWT Statistics, IPG I/II vs. IPG Total, SUADPS

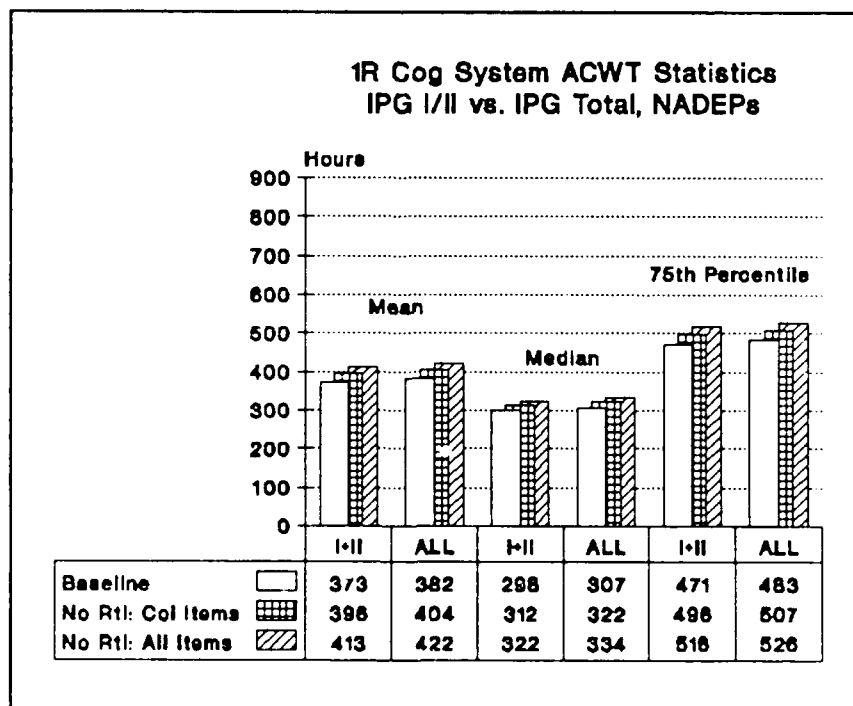


Figure 6 1R Cog System ACWT Statistics, IPG I/II vs. IPG Total, NADEPs

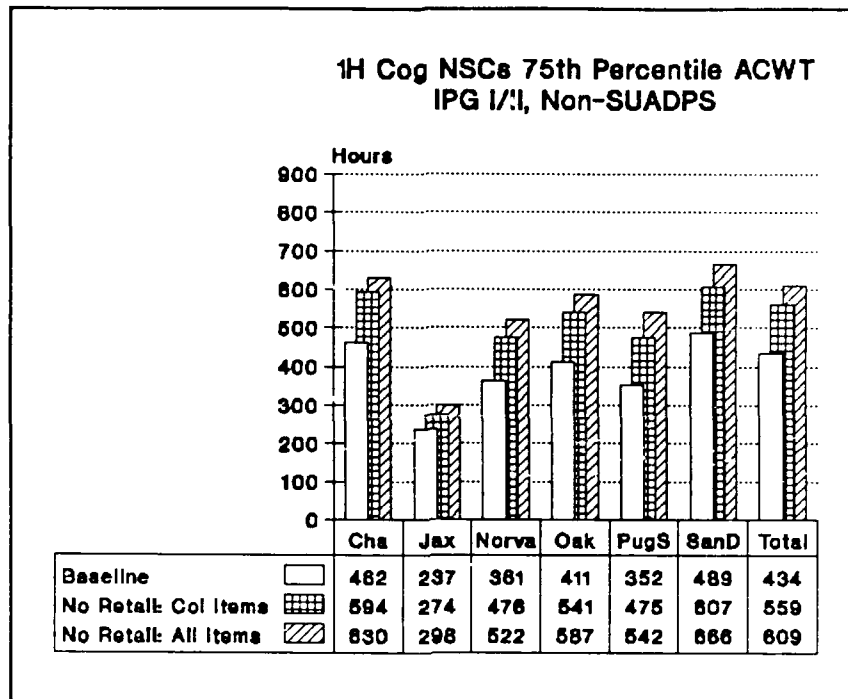


Figure 7 1H Cog NSCs 75th Percentile ACWT, IPG I/I, Non-SUADPS

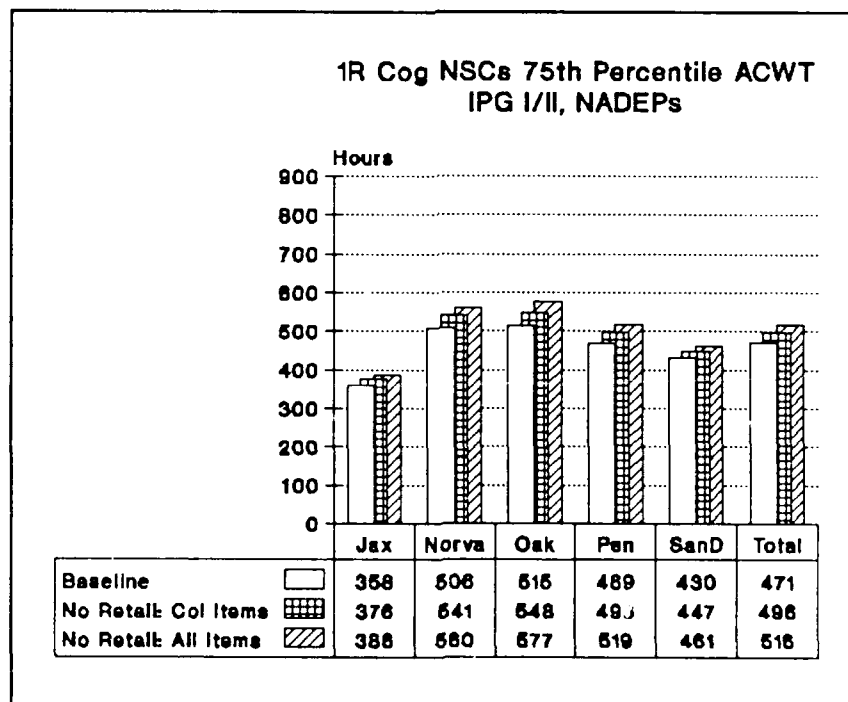


Figure 8 1R Cog NSCs 75th Percentile ACWT, IPG I/II, NADEPs

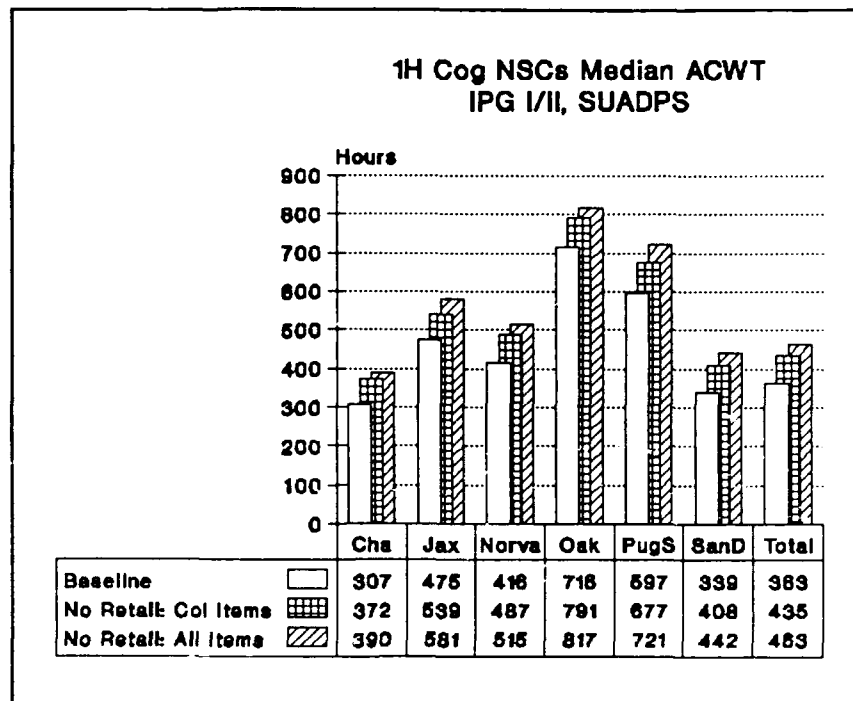


Figure 9 1H Cog NSCs Median ACWT, IPG I/II, SUADPS

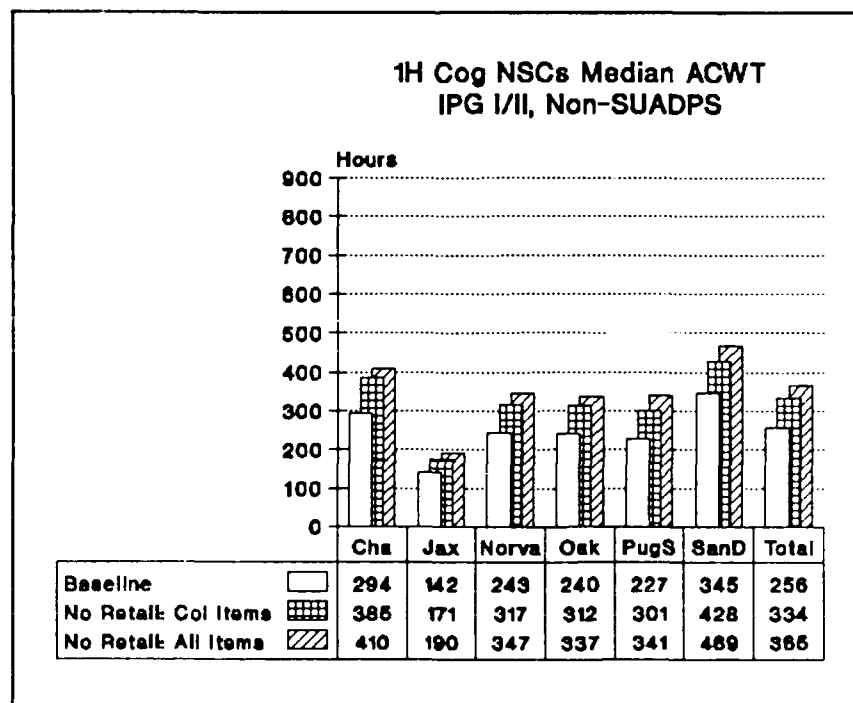


Figure 10 1H Cog NSCs Median ACWT, IPG I/II, Non-SUADPS

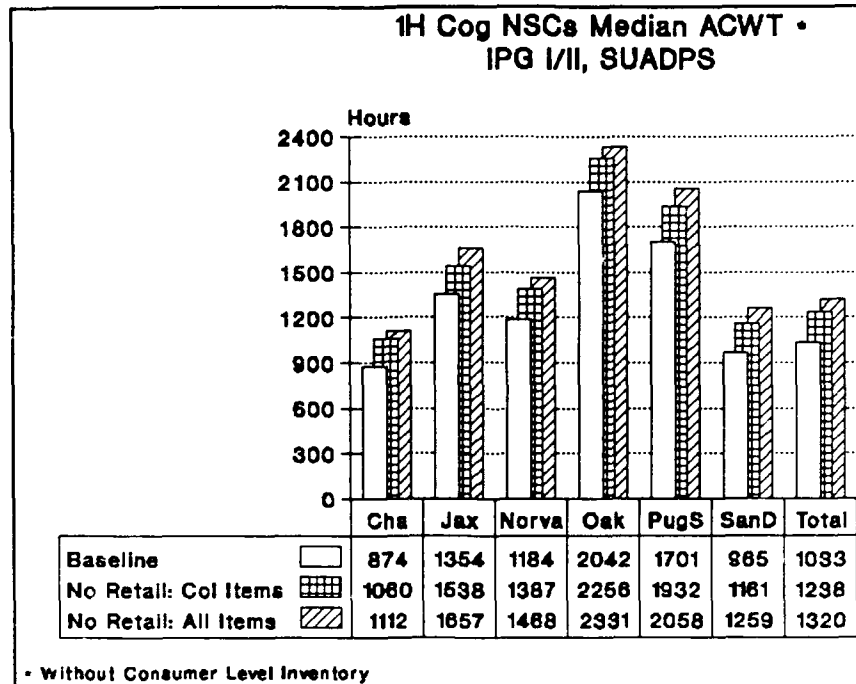


Figure 11 1H Cog NSCs Median ACWT w/o Consumer Level Inventory, IPG I/II, SUADPS

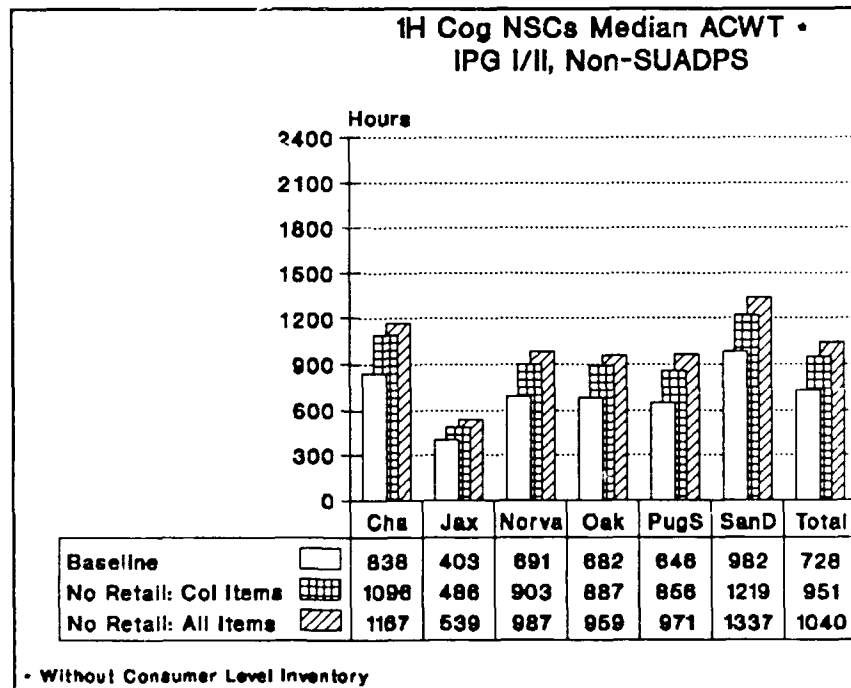


Figure 12 1H Cog NSCs Median ACWT w/o Consumer Level Inventory, IPG I/II, Non-SUADPS

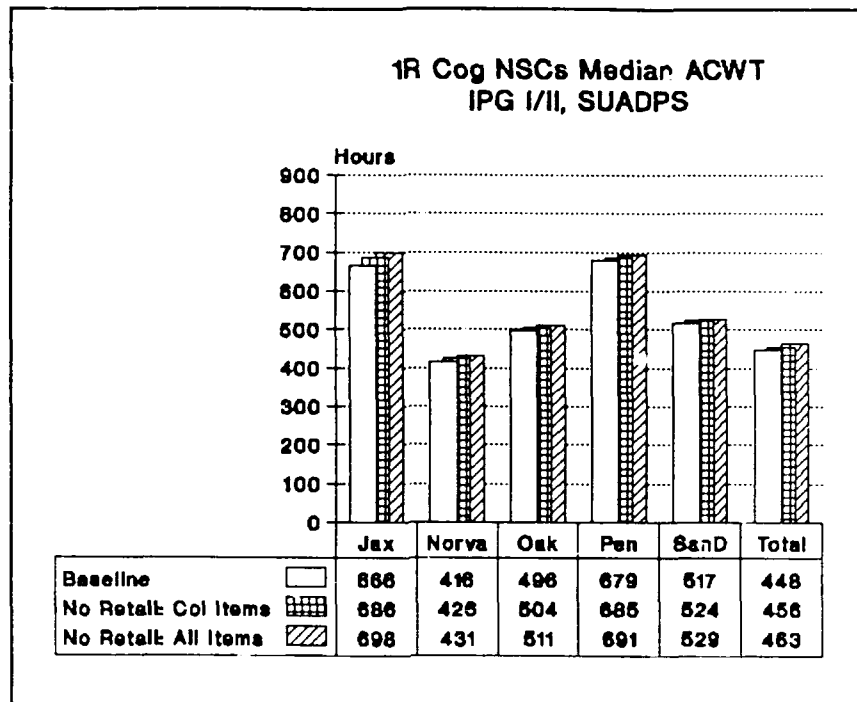


Figure 13 1R Cog NSCs Median ACWT, IPG I/II, SUADPS

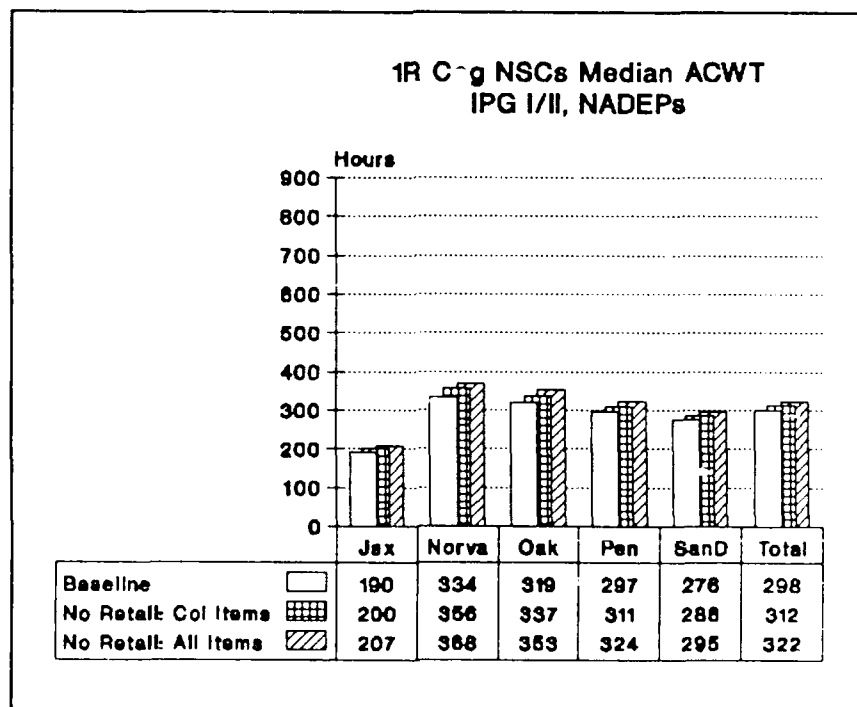


Figure 14 1R Cog NSCs Median ACWT, IPG I/II, NADEPs



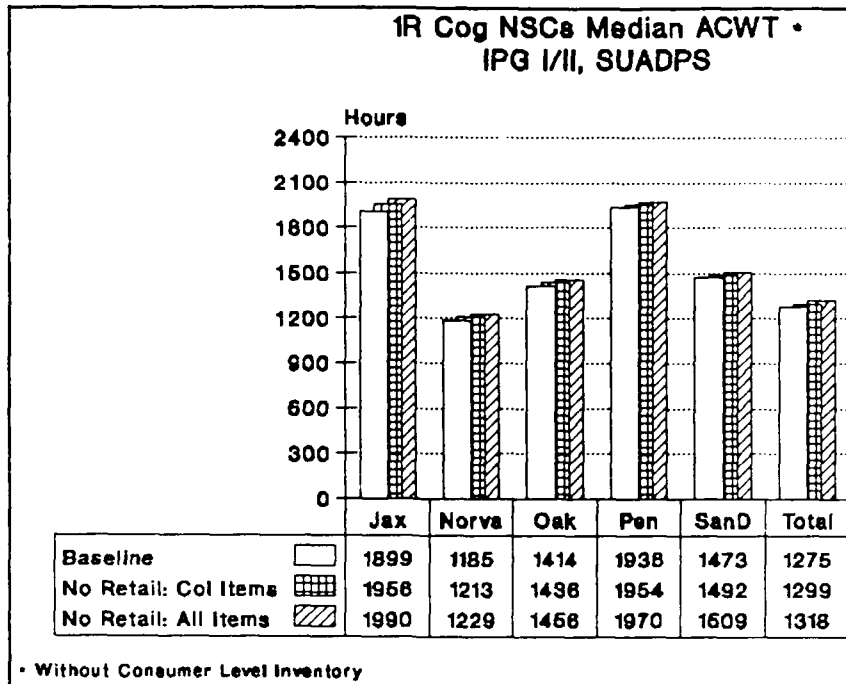


Figure 15 1R Cog NSCs Median ACWT w/o Consumer Level Inventory, IPG I/II, SUADPS

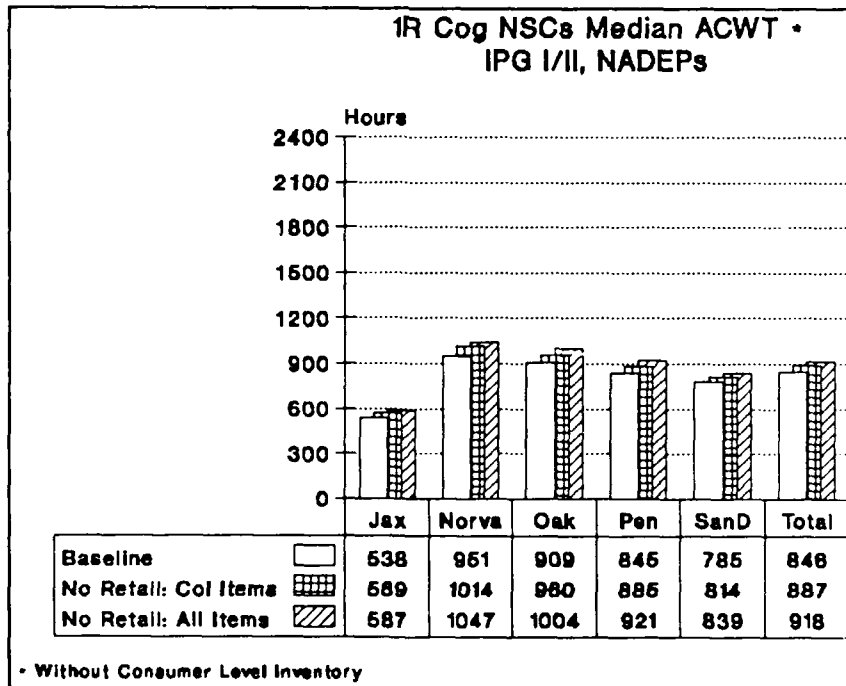


Figure 16 1R Cog NSCs Median ACWT w/o Consumer Level Inventory, IPG I/II, NADEPs

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13. ABSTRACT This study quantifies the extent of improved customer support provided by intermediate levels of inventory collocated with wholesale levels of inventory. An October 1986 General Accounting Office (GAO) audit (Report NSIAD-87-19) recommended that Naval Supply Systems Command (NAVSUP) eliminate intermediate inventories which are collocated with wholesale inventories.  This report addresses four major areas: (1) the extent of collocation of intermediate/wholesale inventories, (2) the impact on intermediate inventory levels resulting from the removal of the collocated intermediate levels, (3) the degradation in Average Customer Wait Time (ACWT) resulting from eliminating collocated inventories, and (4) the cost to maintain the current ACWT given the removal of collocated intermediate levels.  Our analysis reveals that the removal of <u>collocated intermediate levels</u> produces a one-time inventory reduction of \$5.6M for 1H Cog and \$5.8M for 1R Cog, but inflates ACWT by at least 20% (72 hours) for 1H Cog and 5% (14 hours) for 1R Cog. To maintain current ACWT while eliminating the collocated intermediate level, we estimate the wholesale levels would require a substantial increase in investment (\$43.8M for 1H Cog, \$87.1M for 1R Cog) of at least eight times the decrease realized by the elimination of intermediate levels. In addition to the one-time costs, annual costs to hold and maintain these additional wholesale inventories will exceed the annual savings in intermediate inventories by this same factor of at least eight to one. Therefore, the elimination of intermediate levels for collocated wholesale material is not considered cost-beneficial.			

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